Chapter III

AFFECTED ENVIRONMENT/ ENVIRONMENTAL CONSEQUENCES

I. Introduction

This chapter presents a description of the affected environment and how it may be affected by the 250/5000 and 500/5000 Alternatives and the No Action Alternative. This chapter is organized by resource topic. Under each resource is an overview which presents a summary; the overview is followed by a discussion of the affected environment, the methodology used to determine impacts, and the impacts analysis. As described in chapter II, the No Action Alternative does not represent existing conditions, but represents a continuation of conditions from 1973 to 1991 (historical period).

The action alternative impact analyses present long-term effects on resources. This assumes that the Animas La-Plata Project (ALP Project) is in operation and the Navajo Indian Irrigation Project (NIIP) is at full delivery. There would, however, be an interim period between beginning Navajo Dam re-operations and the full development of projects such as NIIP. In this interim period additional water would be available to meet other purposes. As indicated in chapter II, the use of this additional water would be determined through the Navajo Unit operations meeting process. One likely interim scenario is to use this water to maintain higher flows in the river during the irrigation season.

In both the short and long term, dam releases during the non-irrigation season would be reduced to 250 cfs frequently under the Preferred Alternative. While long-term effects are presented in this chapter, interim effects on certain resources are also taken into account.

In this chapter, the resources described first are those potentially affected by or central to changes in the operation of Navajo Dam and Reservoir—hydrology, Indian Trust Assets

(ITA), trout and native fisheries, recreation, socioeconomics, and others. Those resources determined to be minimally affected or not affected are described at the end of this chapter.

Potential measures to mitigate adverse impacts of Navajo Dam operations on fish and wildlife and other resources with statutory requirements to consider mitigation are presented and are also described in chapter IV.

II. Setting

For purposes of the impact analysis, the study area includes Navajo Reservoir in New Mexico and Colorado, and the San Juan River and its flood plain downstream from the reservoir in New Mexico, Colorado, and Utah to Lake Powell. Under some resource topics—for example, economics and social factors—the study area includes a larger geographic area in order to reflect the scope of impacts to those resources.

The entire San Juan River Basin (Basin) encompasses approximately 25,000 square miles, and the river extends 350 miles from its headwaters in the San Juan and La Plata Mountains of Colorado to Lake Powell. The river has drainages that cross the Ute Mountain Ute and Southern Ute Indian Reservations and the Navajo and Jicarilla Apache Nations. Navajo Reservoir was constructed between 1958 and 1963 and has a capacity of 1.7 million acre-feet, a surface area of 15,610 acres, and 150 miles of shoreline. The San Juan River extends approximately 225 miles from Navajo Dam to the San Juan arm of Lake Powell near Paiute Farms.

Below Navajo Dam, the San Juan River is joined by its major tributary, the Animas River, near Farmington, New Mexico. It flows west and northwest before entering Colorado near the Four Corners Monument then flows into Utah and Lake Powell within the Glen Canyon National Recreation Area.

The region south of the San Juan River is characterized by desert landscape—broad dry washes carry significant sediment loads during periodic thunderstorms. The area is semiarid to arid; the major part of the basin is less than 6,000 feet in elevation and receives less than 8 inches of precipitation annually. Vegetation ranges from pinon-juniper around Navajo Reservoir to desert shrubs and grasses near the lower San Juan River. The San Juan River corridor supports riparian vegetation such as cottonwood, willow, and non-native salt cedar and Russian olive.

Towns and communities in New Mexico in the study area include Farmington at the confluence of the San Juan and Animas Rivers; Bloomfield, Blanco, and Archuleta upstream; and Fruitland and Shiprock downstream from Farmington. Bluff and Mexican Hat, Utah, are located on the lower reaches of the San Juan River. Energy development, agriculture,

power production, tourism, and recreation are important industries in the area. In particular, agriculture, power production, and recreation are closely related to Navajo Reservoir and its operations and resulting flow patterns in the San Juan River.

The frontispiece map shows the general project area. In the text and on the following map (figure III-1), the river is demarcated with river mile (RM) designations, starting with RM 0 at Paiute Farms and ending with RM 225 at Navajo Dam. In addition, the map identifies the approximate location of gaging stations and primary locations along the San Juan River.

III. Affected Resources

WATER USES AND WATER RESOURCES

This section addresses the potential impacts to water rights and water supplies that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect water rights, riverflows, reservoir levels, and water use?

Overview

Scope

The scope includes Navajo Reservoir and the San Juan River to Lake Powell.

Summary of Impacts

The No Action Alternative would not impact senior water rights[1]. However, there could be adverse impacts to future water development, including uses for which water rights and environmental clearances[2] are in place, because the Flow Recommendations[3] would not be met.

[1] These water rights are senior to Navajo Reservoir storage permits.
[2] Primarily compliance with the Endangered Species Act (ESA).
[3] *Flow Recommendations for the San Juan River* (Flow Recommendations) (Holden, 1999.)

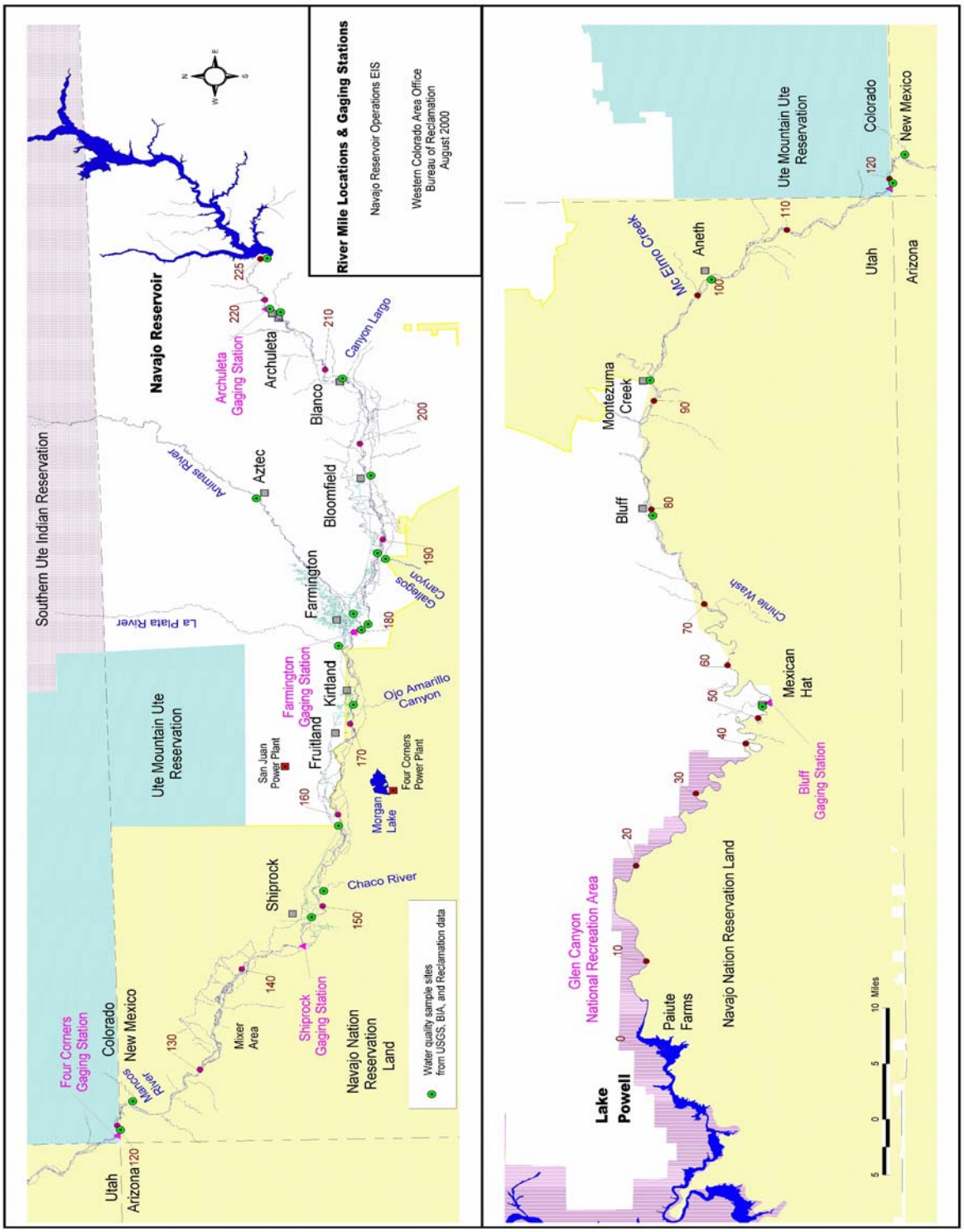


Figure III-1.—River mile locations and gaging stations.

The 250/5000 Alternative would meet the Flow Recommendations; allow delivery of downstream senior water rights; allow construction of the ALP Project; allow completion of NIIP; and support existing water contracts from Navajo Reservoir. In addition, this alternative provides the best opportunity for accomplishing future American Indian (Indian) and non-Indian water development.

The 500/5000 Alternative would meet downstream senior water right deliveries. However, it could adversely impact future water development for which valid water rights and environmental clearances are in place; it does not fully meet the Flow Recommendations; and it limits the availability of water for future Indian and non-Indian water development.

Impact Indicators

Impacts to water resources are indicated by effects on the following: (1) senior water rights holders or contractors from the Navajo Reservoir supply; (2) existing water uses in the Basin; (3) identified future uses for which valid water rights and environmental clearances are in place; (4) meeting Flow Recommendations formulated by the San Juan River Basin Recovery Implementation Program (SJRBRIP) for conservation of endangered fish and designated critical habitat; (5) future water development, including the exercise of Indian water rights under the protection of the Department of the Interior; (6) the Upper Basin States' ability to fully develop and consistently use their compact apportionment.

Affected Environment

Navajo Reservoir

Navajo Reservoir has a maximum content of 1,701,300 acre-feet as measured at the spillway crest (at elevation 6,085 feet) with a corresponding water surface area of 15,610 acres. The inactive content, defined as the storage below the NIIP inlet works, is 625,675 acre-feet with a corresponding water surface elevation of 5,985 feet.

San Juan River

The San Juan River below Navajo Dam is the largest river in the Basin and collects inflow from perennial tributaries—the Animas, La Plata, and Mancos Rivers—and other intermittent tributaries. At its confluence with Lake Powell, the San Juan River produces

a long-term average natural flow[4] of about 2.03 million acre-feet[5] (MAF). The San Juan River above the Animas River confluence contributes about half this amount.

Mean annual runoff to the river at Farmington just downstream of the confluence with the Animas River is about 1.3 MAF under present depletion conditions. Near Bluff, Utah, mean annual runoff increases to about 1.4 MAF under present conditions. The increase is accounted for by tributary inflow below Farmington and irrigation return flow from NIIP.

As with the other rivers, flow peaks in the springtime and remains low from summer to fall, punctuated by short-duration peaks resulting from storm events. The river is partially regulated by Navajo Dam, and its tributaries are substantially used for irrigation. Navajo Dam has tended to reduce peak spring flows and to supplement flows in other seasons since its operation began in 1962. Figure II-1 in chapter II depicts the San Juan River near Bluff, Utah, comparing pre-dam, post-dam, and natural flow mimicry (SJRBRIP test period flows).

Water Rights Background

American Indian (Indian) Trust Water Rights.—Indian trust water rights are under the protection of the Secretary of the Interior as Indian Trust Assets (ITA), as discussed further in the ITA/Environmental Justice (EJ) section of this chapter. Of note are unquantified water rights of the Navajo Nation and other senior water rights that have not obtained Endangered Species Act (ESA) clearance. Under various legal doctrines, including the reserved water rights doctrine (*Winters* v. *United States*) (below), the Navajo Nation claims sufficient water from the river necessary to create a permanent homeland for the Navajo people. These claims are extensive and, if exercised, could place in conflict most of the water in the Basin. Among major treaties, water rights settlements, and other laws involving Indian water rights are the following:

(1) Jicarilla Apache Tribe Water Rights Settlement Act (P.L. 102-441) of 1992, and the Contract Between the United States and the Jicarilla Apache Tribe, December 8, 1992.

[4] Natural flow - Flows that would exist in the San Juan River excluding any man-made uses of the flows.
[5] Natural flows data for the period 1929-1993 developed by Reclamation for the San Juan River Basin Recovery Implementation Program (SJRBRIP).

(2) Treaty between the United States of America and the Navajo Tribe of Indians of 1849 (ratified by the Senate September 9, 1850; proclaimed by the President September 24, 1850; 9 Stat. 974), and Treaty between the United States of America. and the Navajo Tribe of Indians (concluded June 1, 1868; ratification advised July 25, 1868; proclaimed August 12, 1868; 15 Stat. 667).

(3) Colorado Ute Indian Water Rights Settlement Act of 1988 (P.L. 100-585) and Colorado Ute Indian Settlement Act Amendments of 2000.

(4) The Winters Doctrine (see ITA/EJ section), which, under a U.S. Supreme Court ruling, establishes that Indian reservations have the amount of water necessary to satisfy the purposes of the reservation, with a water right priority date no later than creation of the reservation. Unlike other water rights under State law, Winters Doctrine rights are not lost through nonuse.

***Non-Indian Trust Water Rights.*—**Non-Indian trust water rights in the Basin are administered by the States of Arizona, Colorado, New Mexico, and Utah according to State water law and to the interstate compacts that divide the use of the waters of the Colorado River and its tributaries among the Colorado River Basin States. The interstate compacts, or portions thereof, affecting the distribution of the waters in the Basin are listed and briefly summarized here.

(1) *Colorado River Compact* – Divides the Colorado River Basin at Lees Ferry, Arizona into the Upper and Lower Basins, apportions to the Upper Basin the right to the beneficial consumptive use of 7.5 MAF per annum, and requires the States of the Upper Basin to not cause the flow at Lees Ferry to be depleted below a total of 75 MAF for any period of 10 consecutive years.

(2) *Upper Colorado River Basin Compact* – Subject to the provisions and limitations contained in the Colorado River Compact, the Upper Colorado River Basin Compact, among other things, divides consumptive use, apportions to, and makes available for use each year by the Upper Basin States, amounts as follows:

- ❑ Arizona – 50,000 acre-feet per annum; or of the amount remaining after deduction of use made in Arizona
- ❑ Colorado – 51.75 percent
- ❑ New Mexico – 11.25 percent

- ❑ Utah – 23 percent
- ❑ Wyoming – 14 percent

Furthermore, the Upper Colorado River Basin Compact (Article XIV) apportions the water of the San Juan River and its tributaries in Colorado and New Mexico to and between the States of Colorado and New Mexico. In short, within the limitations described in Article XIV, the State of Colorado agrees to deliver to New Mexico from the San Juan River and its tributaries water sufficient to enable New Mexico to make full use of its Compact apportionment subject to satisfaction first of water uses made at the time the Compact was signed and water uses contemplated by water projects authorized at the time the Compact was signed.

(3) *La Plata River Compact* – This compact divides the waters of the La Plata River between the States of Colorado and New Mexico. In short, each day during the period February 16 through November 30 of each year, Colorado is to deliver to New Mexico 100 cubic feet per second (cfs), or an amount equivalent to one half of the mean daily flow at the Hesperus Gage for the preceding day, or the amount of water then needed for beneficial use in the State of New Mexico, whichever is less.

(4) *Animas-La Plata Compact* – This compact states that the water rights to store and divert water for project use in New Mexico shall be of equal priority with those rights granted by the Colorado State courts for project water uses in Colorado.

New Mexico.—

New Mexico Water Law.—New Mexico water law is based on the prior appropriation doctrine. Basically, the first user (appropriator) in time has the priority to take and use water. The State Engineer has the primary responsibility for supervision, measurement, appropriation, administration, and record-keeping. The State courts have primary responsibility with respect to quantifying water rights when there is a general stream adjudication.

Navajo Nation and Jicarilla Apache Nation Uses.—For much of its path from Navajo Dam to Lake Powell, the San Juan River either flows through or forms the northern boundary of the Navajo Nation. The San Juan River represents a critical resource for the Navajo Nation. The Basin has not been fully adjudicated and the Navajo Nation reserved water rights in the Basin have not been quantified, as noted above. The State of New Mexico and the Navajo Nation are currently engaged in negotiations to attempt to settle the Nation's water rights claims in the Basin in New Mexico. Impacts of alternatives on Navajo Nation water rights are discussed in the ITA/EJ section in this chapter.

Jicarilla Apache Nation water rights were approved by Congress in the 1992 Jicarilla Apache Tribe Water Rights Settlement Act. Impacts of alternatives on Jicarilla Apache Nation water rights are also discussed in the ITA/EJ section.

Water Permits Held by the United States.—In the early 1950s, planning for development of the water supply apportioned to New Mexico by the Upper Colorado River Basin Compact was concentrated on several major Federal projects that would put to use the undeveloped water available to New Mexico. The filing on water rights by private entities and subsequent related activities—coupled with the advanced planning for the Federal projects for which no water had been reserved by a water right filing—led the New Mexico Interstate Stream Commission to file several notices of intention for water use which were later assigned to the Department of the Interior. Reclamation filed an additional notice of intention in 1957 for additional water to be provided from Navajo Reservoir. Reclamation filed an Application for Permit on File No. 2848 on February 20, 1958 and on File Nos. 2847, 2849, 2873, and 2917, which were treated as one combined filing on March 6, 1958. Table III-1 lists the New Mexico permits now held by Reclamation for water use in the Basin. Water uses by the San Juan-Chama Project, the NIIP, and under other contracts for the Navajo Reservoir supply must share shortages in the supply in accordance with Public Law 87-483l.

Under contracts with the Secretary of the Interior, users of the Navajo Reservoir water supply include the Navajo Nation for use on the NIIP, the Jicarilla Apache Nation pursuant to the Jicarilla Apache Tribe Water Rights Settlement Act, and several small-use contractors.

Other Water Rights on the Mainstem downstream of Navajo Dam.— The San Juan River and its tributaries are the source from which New Mexico's entire Upper Colorado River Compact apportionment is derived. There are numerous water rights in New Mexico on the San Juan River mainstem downstream of Navajo Dam. The water is used for municipal and industrial (M&I) purposes and irrigation. The water right holders between Navajo Dam and the confluence of the Animas River are being considered in this DEIS as potentially most affected. The potential effects on the ability of the Southern Ute Indian Tribe, the Ute Mountain Ute Tribe, the Navajo Nation, and the Jicarilla Apache Nation to utilize their water rights are also discussed in the ITA/EJ section. Table III-2 shows a listing of the water rights between Navajo Dam and the confluence of the Animas River.

Colorado. —Colorado water law is based on the prior appropriation doctrine, which states that the first appropriator in time has the first priority to take and apply water to beneficial use without waste. The right to divert the unappropriated waters of any natural

Table III-1— New Mexico permits held by Reclamation[1]

Office of State Engineer file numbers	Purpose	Diversion quantity (acre-feet/year)	Priority dates
2847	San Juan-Chama Project	235,000	6/17/55
2848	Hammond Project	23,000	6/17/55
2849	Navajo Indian Irrigation Project	630,000	6/17/55
2873	Navajo Reservoir evaporation loss	28,800	1/17/56
2883	Animas-La Plata Project	49,510	5/1/56
2917	Irrigation, domestic, industrial, mining, and power purposes	225,000	9/16/57
2847, 2849, 2873, and 2917 combined	(Purpose not listed by State of New Mexico)		3/6/58
3215	Municipal and industrial purposes (Note: permit is a direct flow right)	500 cfs	12/16/68

[1] The diversion numbers reflect only diversion values in the permits and do not reflect diversions that are actually taking place under the permits. Diversions under some of the permits are currently taking place, some permits are partially being used, and some permits are not presently being used.

stream to beneficial uses is never to be denied under Colorado's constitution; the Colorado water courts grant decrees to use water and set priorities. The Colorado State Engineer and the Division of Water Resources administer the water rights according to the priorities, measure flows, and record the use of water. Colorado's compact apportionment can be derived from many river sources, including the San Juan River.

Numerous water rights exist in Colorado on the San Juan River mainstem upstream of Navajo Dam and on tributaries to the San Juan River. The only water right in Colorado on the mainstem of the San Juan River below Navajo Dam belongs to the Ute Mountain Ute Tribe. The Colorado Ute Indian Water Rights Final Settlement Agreement gave the Ute Mountain Ute Tribe a reserved priority water right under Colorado law for a direct flow diversion of 1,600 acre-feet per annum (not to exceed a diversion rate of 10 cfs) from the mainstem in Colorado with a priority date of 1868. The settlement also addresses Colorado Ute Indian water rights on the following rivers: Mancos, Animas, La Plata, Florida, Piedra, and the upper San Juan tributaries.

Arizona.—As stated above, the San Juan River either flows through or forms the northern boundary of the Navajo Nation. The mainstem of the San Juan River does not flow

Table III-2—List of water diversion rights and priority dates in New Mexico

Water rights between Navajo Dam and the Animas River confluence		
User	Priority dates	Diversion rights (cfs)
Citizens Ditch	1879, 1881, 1900[2], 1907, 1920[1], 1951, 1954, 10/24/55, 5/1/56[1] (ALP Project)	100
La Pumpa Ditch (diverted through Citizens Ditch)	1888	10
Jaquez Ditch (diverted through Citizens Ditch)	1878	12
Navajo Dam Water Users Association	5/1/56[1] (ALP Project), 1973	2
Turley-Manzanares Ditch	1876	6
Hammond Canal	1944, 1947, 6/17/55 (Reclamation filing)	90
Giant Refinery	1881, 1907, 1947, 10/24/55, 5/1/56[1] (ALP Project)	2
Lee/Hammond Water Plant	1878[1], 1881, 1896[1], 1907, 1920[1], 1930, 1946, 1947, 1953, 10/24/55, 5/1/56[1], (ALP Project)	3
City of Farmington	1907, 1947, 10/24/55/, 5/1/56[1] (ALP Project)	55
	Subtotal	280

Notes:
(1) Above information obtained from State of New Mexico, Office of the State Engineer in a letter dated July 6, 2000. (2) All priority dates are for the San Juan River unless otherwise indicated.
(3) ALP Project (under a Reclamation filing)

[1] Animas River priority date.
[2] Pine River priority date.

through Arizona; however, all tributaries in Arizona to the San Juan River are on the Navajo Nation Reservation Lands. Water rights for the Navajo Nation on the tributaries in Arizona have not been quantified. The Navajo Nation claims sufficient water from these tributaries necessary to create a permanent homeland for the Navajo people.

Arizona is limited to an annual consumptive use of 50,000 acre-feet of water from the Upper Basin pursuant to its apportionment under the Upper Colorado River Basin Compact. Currently, the total consumptive use of water in the Upper Basin in Arizona is about 45,000 acre-feet per year. An existing contract between the Secretary of the Interior and the Navajo Power Plant effectively obligates water not presently being consumed under the 50,000 acre-feet.

Utah.—In Utah, water law is also based on the prior appropriation doctrine and water use is managed in a manner similar to that of the State of Colorado.

In Utah, the San Juan River forms the northern boundary of Navajo Nation Reservation Lands. The same principle applies here with respect to the Navajo Nation claims for sufficient water to provide a permanent homeland for its people.

A number of non-Indian water rights exist on the north side of the San Juan River and on tributaries that drain into the San Juan River from the north. The Colorado River Compact requires that uses in the Upper Basin be administered and flows be regulated in a manner sufficient to deliver to Lees Ferry from the Upper Colorado River and San Juan River Basins combined the volume of flow specified by the Compact, but it does not require that a specific flow volume necessarily be contributed by the San Juan River. The Glen Canyon National Recreation Area may have an unquantified Federal reserved water right on the San Juan River arm of Lake Powell. This right would be junior to that for Navajo Reservoir and Reclamation has no obligation to deliver water for this right[6].

Methodology

The following measures were used to evaluate the impacts to water rights and uses under the No Action, 250/5000, and 500/5000 Alternatives.

- ❑ Researching the number of water rights and quantifying the amounts of water associated with each water right.

- ❑ Researching available water diversion records and determining possible impacts due to changes in flows in the San Juan River resulting from changes in the operation of Navajo Reservoir.

- ❑ Examining and comparing a hydrologic model output for each alternative to historical flows to determine possible variations in flow from the future operation of Navajo Reservoir and the way in which these variations may affect water use.

- ❑ Observing actual operations of the diversion structures during the Summer Low Flow Test conducted from July 9 to July 15, 2001 (Reclamation, 2002b). Operations of diversion structures under high flow (5,000 cfs) conditions were observed during the Navajo Reservoir spring releases of 1998 (see the "Diversion Structures" section of this chapter).

[6] Personal communication between National Park Service and Reclamation, February 6, 2002.

Impact Indicators

Impacts to water resources are indicated by effects on the following: (1) senior water right holders or contractors from the Navajo Reservoir supply; (2) existing water uses in the Basin; (3) identified future uses for which valid water rights and environmental clearances are in place; (4) meeting Flow Recommendations formulated by the SJRBRIP for conservation of endangered fish and designated critical habitat (figure III-2); (5) future water development, including the exercise of Indian water rights under the protection of the Department of the Interior; (6) the Upper Basin States' ability to fully develop and consistently use their compact apportionment.

These areas are described further below, and are also arrayed in summary form under each alternative.

(1) An underlying assumption in analysis of the impact to water resources was that there could be no adverse impact to existing active water uses in the Basin. All existing depletions are intended to be represented in the hydrology model used for analysis. Comparing the modeled depletions with and without implementing the action reveals differences among the alternatives.

(2) Future uses with valid water rights and environmental clearances, when necessary, were handled in the same manner as existing active water uses using the same impact indicators[7].

(3) The Flow Recommendations provide flow criteria for the San Juan River below Farmington which, if met, are anticipated under the current status of knowledge to produce and maintain habitat needed to recover the two endangered fish species in the San Juan River. Flow statistics based on the modeled period of 1929-93 were compared to the Flow Recommendations criteria and Navajo Dam operations were adjusted until the Flow Recommendations could be met. Not meeting one or more of the flow criteria was considered to be an adverse impact to the endangered fish.

(4) The following projects may be impacted by the alternatives: (1) Colorado Ute and Navajo Indian water uses pursuant to the 1988 Colorado Ute Settlement Act and the 2000 Settlement Act Amendments (which also authorize the ALP Project and its component Navajo Nation Municipal Pipeline); (2) Jicarilla Apache Nation water uses pursuant to the 1992 Jicarilla Apache Tribe Water Right Settlement Act; (3) Completion of the NIIP; (4) development of a planned project that includes delivery of M&I water (Navajo-Gallup Water Supply Project); (5) Proposed

[7] For example, completion of NIIP was modeled as a depletion for its full water rights acreage.

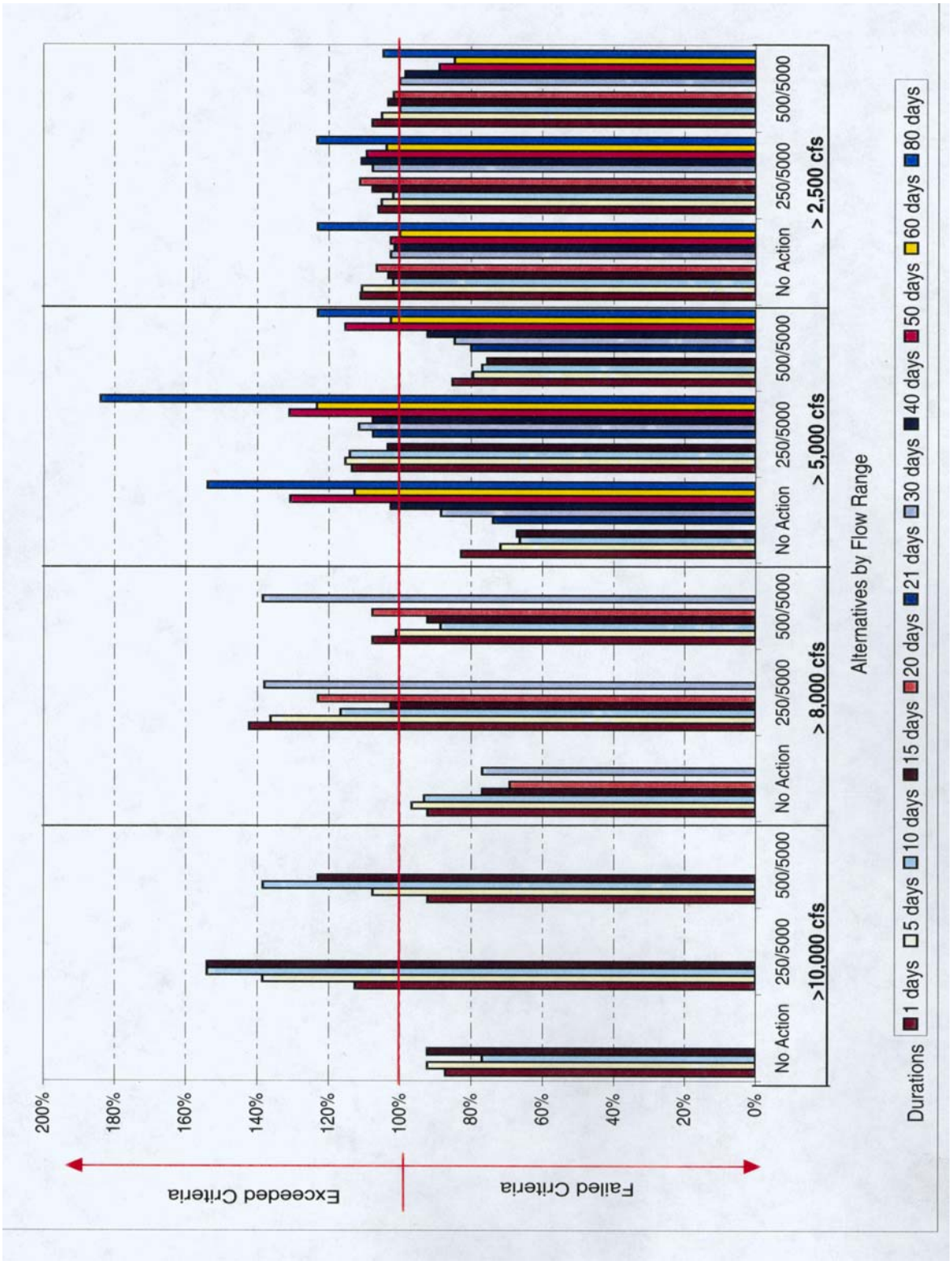


Figure III-2.—Degree to which viable alternatives meet Flow Recommendations.

irrigation rehabilitation (Hogback Project) for the Navajo Nation; (6) the exercise of senior Indian water rights for uses without environmental clearance (more detail is provided in the ITA/EJ section in this chapter); and (7) Florida and Mancos water contracts.

(5) The Upper Basin States' ability to fully develop and consistently use their compact apportionment was taken into consideration.

Impacts Analysis

No Action Alternative

Reservoir elevations for the No Action Alternative would generally be higher than those under the other alternatives because full NIIP acreage would not be irrigated and there would be less demand on the reservoir. The No Action Alternative July through January releases are almost twice those of the other alternatives, while average releases for May are less than under the other alternatives. This is a function of increased releases from July through December to meet end-of-December storage targets and decreased releases in the spring as a result of not operating Navajo Dam to meet the Flow Recommendations.

The application of evaluation criteria (see the previous indicators discussion) disclosed the following impacts:

(1) Under the No Action Alternative, streamflows would generally follow the pattern observed historically during the 1973 to 1991 period, but would be modified to the extent that modeled water uses differ from historical water uses that actually occurred during that period. Streamflow could be developed for future uses within the limitations of State water laws, interstate agreements, and appropriate environmental compliance. On the San Juan River, future operations are expected to follow operations that occurred from the time the reservoir first filled in 1973 until 1991 when operations were modified to assist in the 7-year research period, as described in the Flow Recommendations. Unspecified current uses could be impacted.

(2) Adverse impacts are anticipated to identified future uses for which valid water rights and environmental clearances are in place. If the Flow Recommendations cannot be met, it is unclear whether the Fish and Wildlife Service (Service), under its ESA responsibilities, could find reasonable and prudent alternatives (RPAs) to allow future water development to proceed.

A failure to develop the ALP Project, to complete the NIIP, to fulfill the Jicarilla Apache Nation third-party water contract with PNM, and to implement other

water projects could put future development of Indian water rights settlements in jeopardy, and consequently, cause presently used non-Indian water rights in the Basin, particularly in Colorado and New Mexico, to be at risk to Indian senior water rights claims.

(3) Adverse impacts are anticipated to the protection and recovery of endangered fish species because the Flow Recommendations cannot be met.

(4) Adverse impacts to future development, including ITAs, could be expected.

(5) Adverse impacts could occur to New Mexico and Colorado in using their compact apportionments due to the impact to future water development.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

Under the 250/5000 Alternative, the spring releases from Navajo Dam would reach 5,000 cfs when sufficient water was available, and releases would be decreased to as low as 250 cfs when necessary to provide the recommended flows through the critical habitat area and to conserve water. A 250 cfs release from Navajo Reservoir during the irrigation season would result in very low flows from below the Citizens Ditch diversion to the Animas River confluence due to irrigation diversions; however, during the Summer Low Flow Test, it was determined that a 250 cfs release would meet senior water rights. During low water periods, Reclamation would follow New Mexico State water law regarding downstream water rights. This alternative, by meeting the Flow Recommendations, provides the best opportunity for effectuating Indian water rights settlements and accomplishing future Indian and non-Indian water development.

The application of evaluation criteria (see the previous indicators discussion) disclosed the following impacts:

(1) Potentially adverse impacts could occur to existing diversions in the San Juan River from Navajo Dam to Farmington, New Mexico, as a result of project operations that would reduce minimum releases from Navajo Dam to 250 cfs. A Summer Low Flow Test was conducted July 9 to July 16, 2001, to evaluate the effects of low summer flows on various resources. The Summer Low Flow Test indicated that the water supply would not be a problem for most diverters, though inadequate facilities may have contributed to some shortages. Three diversions were adversely impacted during the test. (See "Diversion Structures" section in this chapter.)

During the Summer Low Flow Test, a minimum flow of 63 cfs was measured below the Hammond Diversion. Under actual conditions, flows could be higher or lower than flows measured due to variations in dam releases, side inflows, diversions, canal wastes, and weather conditions.

(2) There would be no impact to existing water uses and future uses that have environmental clearances.

(3) Modeling has shown that the Flow Recommendations criteria for the two endangered fish species could be met and that existing water uses—the Jicarilla Apache Nation's third-party water contract with PNM, NIIP, and the ALP Project—would have an adequate water supply.

(4) The best opportunity for future Basin water development including ITAs is implementation of the 250/5000 Alternative, because future water development could occur as the Basin works toward recovery of endangered fish.

(5) This alternative would result in the least impact among the alternatives to New Mexico's and Colorado's abilities to use their compact apportionments, since future water development would be allowed.

500/5000 Alternative

This alternative is similar to the 250/5000 Alternative, except that Navajo Dam releases would not fall below 500 cfs. Because of the higher minimum release, senior water rights in the San Juan River downstream to Lake Powell would not be impacted. There would be times (infrequent) when NIIP would not be able to divert due to low reservoir levels and the Flow Recommendations criteria would not be fully met. Because this alternative does not meet the Flow Recommendations, new ESA consultations on the ALP Project, NIIP (Blocks 9-11), and the Jicarilla Apache Nation third-party water contract with PNM may be required and could impact the ability to effectuate future Indian water rights settlements; it could also consequently result in risks to presently used non-Indian water rights.

While there may be no impacts to water rights along the San Juan River under the 500/5000 Alternative, there could be negative impacts to water rights in Colorado on the Animas, La Plata, and other rivers if completion and operation of the ALP Project is hindered by this alternative and if the Colorado Ute Tribes reinstate their claims to the waters of those rivers.

The application of evaluation criteria disclosed the following impacts:

(1) Unspecified current water uses could be impacted if reconsultation under the ESA was required.

(2) Adverse impacts could occur to the ALP Project, completion of NIIP, Jicarilla Apache Nation third-party water contract, and 3,000 acre-feet per year of unspecified minor depletions.

(3) The Flow Recommendations would not be fully met as a result of operations that would increase minimum Navajo Reservoir releases from 250 cfs to 500 cfs. The target flow range would be exceeded more frequently than under the 250/5000 Alternative, and hydrologic modeling suggests that the Flow Recommendations criteria for endangered fish flows during the snow melt runoff period could not be met.

(4) Potentially adverse impacts would occur to Indian and non-Indian water development. Projected shortages might suggest that no additional streamflow could be developed for future uses under the 500/5000 Alternative.

(5) Potentially adverse impacts would occur to New Mexico's and Colorado's abilities to fully develop and consistently use their compact apportionments.

INDIAN TRUST ASSETS AND ENVIRONMENTAL JUSTICE

This section addresses the potential impacts to Indian trust assets and environmental justice that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect Indian trust assets and environmental justice?

Overview

Scope

The scope includes Indian trust water rights associated with Navajo Reservoir and the San Juan River and on surrounding trust/reservation lands of the Navajo and Jicarilla Apache Nations and the Ute Mountain Ute and Southern Ute Indian Tribes. It also includes areas of minority and low-income populations in northwestern New Mexico, southwestern Colorado, and southeastern Utah.

Summary of Impacts

No Action Alternative: Without ESA-related approval, future Indian water development projects in the Basin would probably not proceed as planned, and the development of several ongoing Indian water projects that have received environmental clearance would also be impacted.

250/5000 Alternative: Positive impacts would occur for projects which have received environmental clearance; potential negative impacts could exist for some future projects that have not received environmental clearance because of a diminished water supply. However, this alternative has the best potential for future water development.

500/5000 Alternative: There would be occasional shortages to existing projects and less likelihood of future water development when compared to the 250/5000 Alternative.

Impact Indicators

An impact is considered to exist for any action that would

- ❑ Adversely affect the value, use, or enjoyment of an Indian Trust Asset (ITA)
- ❑ Create disproportionately high and adverse human health and environmental effects or other negative project-related impacts to minority and low income populations
- ❑ Disregard the government-to-government relationship which exists between the United States and Indian Nations/Tribes

---

Indian Trust Assets

Introduction

The United States has a trust responsibility to protect and maintain rights reserved by or granted to Indian Tribes by treaty, statutes and executive orders. This trust responsibility requires that Federal agencies such as Reclamation take actions reasonably necessary to protect ITAs. Department of the Interior Secretarial Order Number 3215, dated April 28, 2000, further states:

> The proper discharge of the Secretary's trust responsibility requires, without limitation, that the Trustee, with a high degree of care, skill, and loyalty: Protect and preserve Indian trust assets from loss, damage, unlawful alienation, waste, and depletion.

The Reclamation ITA policy states that Reclamation will carry on its activities in a manner which protects ITAs and avoids adverse impacts to ITAs when possible. When Reclamation cannot avoid adverse impacts, it will provide appropriate mitigation or compensation (Reclamation, 1994).

A basic description of ITAs is as follows:

- ITAs are legal interests in assets held in trust by the Federal Government for federally recognized Indian Tribes or Nations.
- Assets are anything owned that has monetary value. The assets need not be owned outright, but could be some other type of property interest, such as a lease or a right to use something. Assets can be real property, physical assets, or intangible property rights.
- A trust has three components: the trustee, the beneficiary, and the trust asset(s). The beneficiary is also sometimes referred to as the beneficial owner of the trust asset. In this trust relationship, title to ITAs is held by the United States (trustee) for the benefit of a Tribe.
- Legal interest means there is a property interest for which a legal remedy, such as compensation or injunction, may be obtained if there is improper interference.
- ITAs do not include things in which a Tribe has no legal interest. For example, off-reservation sacred sites in which a Tribe has no legal property interest are generally not considered ITAs.
- ITAs cannot be sold, leased, or otherwise alienated without the United States' approval. While most ITAs are located on the reservation, they also can be located off-reservation. Examples of things that could be ITAs include lands, minerals, water rights, hunting and fishing rights, other natural resources, money, or claims.

ITAs have been identified for four federally recognized Tribes within the San Juan River Basin: the Navajo and the Jicarilla Apache Nations and the Southern Ute Indian and Ute Mountain Ute Tribes. ITAs that potentially would be affected by this proposed Federal action appear to be limited to water rights. The proposed action is not expected to affect any treaty-based fishing, hunting or gathering, or similar rights of access and resource use on traditional Tribal lands.

ITAs for these Tribes were examined in the 2000 Final Supplemental Environmental Impact Statement (FSEIS) for the ALP Project (Reclamation 2000a). Information from that report is used in this document.

In *Winters* v. *United States*, the U.S. Supreme Court laid the foundation for Indian water rights which have become known as Winters Doctrine rights. The Court held that the establishment of an Indian reservation carries with it an implied amount of water necessary to satisfy the purposes of the reservation. A water right granted to a Tribe under the Winters Doctrine is given a priority date no later than the time when the reservation was established and, unlike water rights permitted, licensed or adjudicated under State statutes, such rights under the Winters Doctrine cannot be lost through non-use.

Native American human remains, Native American Graves Protection and Repatriation Act (NAGPRA) cultural items, and other cultural property may be considered ITAs by association with land status, treaty or some other statute, but are not considered ITA's by virtue of NAGPRA alone. Therefore, cultural resource issues and mitigation, including sacred sites and NAGPRA issues, are addressed separately in the "Cultural Resources" section in this chapter.

Affected Environment

Approximately 60 percent of the land in the Basin is entrusted to the Indian reservations of the Navajo and Jicarilla Apache Nations and the Southern Ute Indian and Ute Mountain Ute Tribes. Winters Doctrine water rights settlements have been negotiated for three of the four Tribes. Reserved water rights under the Winters Doctrine for the Navajo Nation have not been quantified or settled. Existing and future Tribal uses of San Juan River water are shown in table III-3.

A discussion of the affected environment for each Tribe follows.

Navajo Nation

The affected environment for this analysis includes much of the eastern and northern portions of the Navajo Nation (where adequate domestic water service is lacking), the lands within the NIIP service area, lands served by the Hogback, Fruitland-Cambridge, and Cudei irrigation projects, and irrigation along the tributaries to the San Juan River.

The Navajo Indian Reservation was established by treaty in 1868 (15 Stat. 667), and was expanded by Executive Orders and statutes between 1868 and 1934. The Navajo Nation lands total approximately 26,897 square miles and extend into New Mexico, Arizona, and Utah. The San Juan River runs through the original 1868 reservation, is a major source of

Table III-3.—Summary of existing and future Tribal uses of San Juan River Basin water

Description	Diversion (Acre-feet per year)	Depletion (Acre-feet per year)	Included in environmental baseline[1] for recent ESA consultations
Existing Uses - Navajo Nation			
Navajo Indian Irrigation Project (Blocks 1-8)		149,420	Yes
Hogback Project		12,100	Yes
Cudei Irrigation Project		900	Yes
Fruitland		7898	Yes
Existing Uses - Navajo Nation (New Mexico State water rights)			
Shiprock Helium Plant (permit 2472)		1,400	Yes
Kerr McGee (uranium processing) (permit 2875)		700	Yes
Kerr McGee (permit 2807)		500	Yes
Navajo Methodist School (Navajo Academy)		139.5	Yes
Existing Uses - Jicarilla Apache Nation			
Decreed for historic and existing uses, 1880 priority date	5,683	2,195	Yes
Small third party water service contracts	770	[2]770	Yes
Evaporation - Stock ponds and reservoirs		2,187	Yes
Existing Uses - Ute Mountain Ute Tribe			
Dolores Project	25,100		N/A[3]
Existing Uses - Southern Ute Indian Tribe			
Water allocated to the Tribe from the Florida River	2,000		Yes
Pine River 181.7 cfs and 1/6 interest in Vallecito Reservoir			Yes
San Juan River, 5.64 cfs direct diversion rights, 1868 priority date	1,014		Yes
Piedra River, 2.0 cfs direct diversion, 1868 priority	600		Yes

Note: Blank space indicates information not readily available.

[1] The Service's biological opinions contain a baseline of depletions that are considered in ESA consultations. This baseline is not the same as the depletion table derived for this DEIS.

[2] This 770 acre-feet depletion is allowed under the 3,000 acre-feet minor depletion account allowed for through ESA (Section 7) consultation under the SJRBRIP.

[3] This 25,100 acre-feet is imported from the Dolores River Basin and consumed in the Basin.

Table III-3.—Summary of existing and future Tribal uses of San Juan River Basin water (continued)

Description	Diversion (Acre-feet per year)	Depletion (Acre-feet per year)	Included in environmental baseline for recent ESA consultations
Future Uses - Navajo Nation[1]			
Navajo Nation Municipal Pipeline (ALP Project)	4,680	2,340	Yes
Navajo Indian Irrigation Project (Blocks 9-11)		120,600	Yes
Navajo-Gallup Project (includes 7,500 acre-feet per year for the City of Gallup)	37,764	35,893[2]	No
Hogback Project restoration		16,420	No
Future Uses - Jicarilla Apache Nation			
PNM Third Party Water Service Contract (part of 1992 Water Rights Settlement Act)	16,200	16,200	Yes
Water Rights Settlement Act of 1992 (from San Juan-Chama Project)	6,500	6,500	Yes
Water Rights Settlement Act of 1992 (Remaining from Navajo Reservoir or Navajo River)	16,530	8,530	No
Future Uses - Ute Mountain Ute Tribe (see table I-1, ALP FSEIS for details on Colorado Ute Settlement)			
Animas-La Plata Project		16,525	Yes
San Juan River, 10 cfs direct diversion rights, 1868 priority date	1,600		No
Mancos River direct diversion rights for 7,200 acres, priority date subordinated to 1985	21,000		No
Navajo Wash, 15 cfs direct diversion rights, priority date subordinated to 1985	4,800		No
Tributary groundwater, domestic and livestock wells		1,850	No
Future Uses - Southern Ute Indian Tribe (see table I-1, ALP FSEIS, p. 1-6 for details on Colorado Ute Settlement)			
Animas-La Plata Project		16,525	Yes
Florida River, 6.81 cfs direct diversion rights, priority date subordinated to 1976	1,090		No
Florida River, Project water	563		No

Table III-3.—Summary of existing and future Tribal uses of San Juan River Basin water (continued)

Description	Diversion (Acre-feet per year)	Depletion (Acre-feet per year)	Included in environmental baseline for recent ESA consultations
Stollsteimer Creek, 1,850 acre-feet per year storage, 2 cfs, 3.5 cfs	1,850 +		No
Piedra River, 6.9 cfs direct diversion, 1868 priority date	995		No
Devil Creek, irrigation of 81 acres	183		No
San Juan River, 2.86 cfs direct diversion rights, 1868 priority date	516		No
Round Meadow Creek, 5.4 cfs direct diversion rights, 1868 priority date	975		No
Cat Creek, 8 cfs direct diversion, 1868 priority date	1,372		No
Tributary groundwater, domestic & livestock wells	2,000		No

[1] Does not include 4,000 acre feet of projected groundwater development that will be developed conjunctively with the Navajo Gallup Water Supply.
[2] Includes 1,200 acre-feet for Jicarilla Apache Nation.

water for Navajo Nation agricultural and domestic use, and is the only water source in the northern portion of the reservation capable of being readily developed. Basin water also is used for Tribal mineral development such as the Navajo Mine and production of coal-bed methane. About one-half of all Navajo lands lie within the Basin.

The Navajo Nation claims substantial quantities of water resource ITAs in the Basin, based on historic use and reserved water rights (Winters Doctrine rights); however, reserved rights have not been quantified either through settlement or litigation. The Navajo Nation claims a priority date of no later than 1849 for its water rights, based on the treaty made with the United States in that year (Interior, 2000a)[8], even though the reservation was not established until 1868. Because significant areas of arable Navajo lands lie within the Basin, the Navajo Nation claims a significant amount of the water in the San Juan River. This is based on the practicably irrigable acreage (PIA) standard enunciated in the Supreme Court case of *Arizona* v. *California*. The ultimate claim will depend on the results of a PIA analysis being done by the Bureau of Indian Affairs (BIA) and final adjudication of Navajo water rights in the Basin.

[8] The State of Colorado does not necessarily agree with the Navajo Nation's claimed priority date (CWCB letter dated April 15, 2002).

Only the NIIP, the three San Juan River projects in New Mexico[9] and a small project near Aneth, Utah, might be affected by alternative dam operating criteria. While production from all irrigation tracts or projects on-reservation remains important to the Navajo Nation, it is not currently economically practicable to construct pipelines and pump San Juan River water to the many irrigation tracts or projects scattered throughout the Navajo Indian Reservation.

Operating Navajo Reservoir to meet the Flow Recommendations criteria could affect existing and planned Navajo Nation water development projects as well as the Navajo Nation reserved water rights that have not been quantified. Descriptions follow for several of the largest existing and planned Indian water development projects in the Basin; however, the Navajo Nation's water development interests are not limited to these projects (Navajo Nation, 2000a).

Navajo Indian Irrigation Project.—Navajo Reservoir is the principal water storage facility for the NIIP. Public Law 87-483, enacted in 1962, authorized the Secretary of the Interior to construct, operate, and maintain the NIIP for the purpose of furnishing irrigation water to approximately 110,630 acres; the project was to have an average annual diversion of 508,000 acre-feet. The agreement between the United States and the Navajo Tribe of Indians for Delivery of Water from Navajo Reservoir, executed in 1976, repeats this authorization language from Public Law 87-483, Section 2. However, the diversion amount of 508,000 acre-feet per year was the design diversion amount for flood irrigation of 110,630 acres, a large portion of which were to be located west of Chaco Wash and from Shiprock to the north to Newcomb to the south. The NIIP was later reconfigured to place all the project acreage east of the Chaco River, which greatly reduced overall canal length and water conveyance losses for the project, and to install pressure sprinkler irrigation, which improved irrigation efficiency and reduced farm delivery requirements.

The NIIP includes a water storage and delivery system, lands, roads, utilities, and other facilities for irrigation of project lands located south of Farmington, New Mexico. The Navajo Agricultural Products Industry (NAPI) is a Tribal business enterprise formed in 1970 to develop, farm, operate, and manage the NIIP lands. Both NIIP and NAPI were established to provide profit and employment to the Navajo people. NAPI currently provides approximately 250 permanent jobs and 800 seasonal jobs.

NIIP is being developed in 11 separate blocks of approximately 10,000 acres of irrigable land each. Congress began funding NIIP construction in 1963 and the project began operation in

[9] Hogback, Fruitland, and Cudei Projects.

1976 with the first 10,000-acre block. The project was scheduled for completion in 1986, but funding delays postponed completion. In 2001, facilities to deliver irrigation water to about 65,000 acres in Blocks 1 through 8 were complete. The acreage through Block 8, scheduled for completion and to be in full operation by 2002, totals about 77,040 acres. Construction on Blocks 9, 10, and 11 is scheduled to be completed by 2012, with full irrigated acreage to be reached in 2032.

***San Juan River Irrigation Projects.*—**These irrigation projects along the San Juan River were initiated between 1900 and 1937. In 2000, these projects provided irrigation water to about 5,300 acres. The facilities of these irrigation projects have deteriorated, and a study by Reclamation estimated the rehabilitation at $20 million.

(1) The Hogback Irrigation Project supplies water for lands on the north side of the San Juan River, from the Hogback, located approximately 9 miles east of Shiprock, to about 17 miles northwest of Shiprock. In recent years, the acreage irrigated under the Hogback Project has ranged from an estimated 2,540 acres to about 3,060 acres. In 1991, 16,420 acre-feet per year of depletion was transferred from inactive portions of the Hogback Project to NIIP for ESA consultation purposes. Construction on NIIP Blocks 1-8 was to proceed while research on endangered fish recovery needs took place.

(2) The Cudei Project supplies water for lands on the south side of the river about 6 miles northwest of Shiprock. In recent years, the acreage irrigated under the Cudei Project has ranged from an estimated 240 acres to about 330 acres. The Cudei diversion dam was removed early in 2002, and supply to the project in the future will be via a siphon from the Hogback main canal. The siphon is scheduled to be completed in 2002.

(3) The Fruitland-Cambridge Irrigation Project diversion dam and headworks are located two miles west of Farmington on the south bank of the San Juan River. In recent years, the acreage irrigated under the Fruitland Irrigation Project, including Cambridge, has ranged from an estimated 2,140 acres to about 2,380 acres. The Cambridge Irrigation Project is supplied by the Fruitland Project and is located downstream of the last Fruitland canal wasteway. The Cambridge Project canal is about 3 miles long, beginning at the end of the Fruitland Project, and in 2000 about 60 acres were irrigated in the Cambridge Project area.

Navajo Nation Municipal Pipeline. —The Navajo Nation Municipal Pipeline (NNMP) is authorized as a structural component of the ALP Project to augment a 30-year old pipeline which serves almost 60 percent of the current domestic water uses occurring along the San Juan River between Farmington and the City of Shiprock. The pipeline will deliver 4,680 acre-feet per year of water diverted from the Animas River to supply a depletion of 2,340 acre-feet per year (Reclamation 2000a).

Navajo-Gallup Water Supply Project. —The proposed Navajo-Gallup Water Supply Project is currently planned by the Navajo Nation, Jicarilla Apache Nation, City of Gallup, and Reclamation, in coordination with the BIA. It would provide a safe, reliable, and sustainable municipal and domestic water supply to portions of the Navajo Nation in northwest New Mexico and northeast Arizona, more than 20 Navajo Chapters, and the southwestern part of the Jicarilla Apache Nation reservation. The project would provide water to some areas of the Navajo and Jicarilla reservations that currently do not have adequate domestic water supplies. The project would also serve the City of Gallup, New Mexico. Gallup is not part of the reservation, but many Navajos live or work in Gallup. Feasibility studies for this project were authorized by Congress in Public Law 92-199, enacted December 15, 1971.

The source of water for the project has not been clearly identified. Reclamation is working with the Navajo and Jicarilla Apache Nations and the City of Gallup to identify adequate sources of water. Parties involved in the development of the project are working to resolve issues associated with the delivery and use of Upper Colorado River Basin water in the Lower Colorado River Basin.

As currently envisioned, the project would divert 37,764 acre-feet per year from the San Juan River and deplete 35,893 acre-feet per year, including 7,500 acre-feet per year of diversion and depletion to the City of Gallup, and 29,064 acre-feet per year diversion and 27,193 acre-feet per year depletion for the Navajo Nation. Reclamation and the project sponsors are preparing a planning report and an environmental impact statement.

Jicarilla Apache Nation

The Jicarilla Apache Indian Reservation was created by a series of executive orders between 1874 and 1908. The reservation covers about 880,000 acres (1,375 square miles) in north-central New Mexico. The reservation lies in both Rio Arriba and Sandoval counties and includes 137,150 acres of land purchased by the Apache Nation.

About 80 percent of the reservation is on the west side of the Continental Divide in the Basin. The western boundary of the reservation is approximately 15 miles east of Navajo

Reservoir. The Navajo River, which is tributary to the San Juan River, is a perennial stream on the reservation. The San Juan-Chama Project diverts approximately 52 percent of the average annual flow of the Navajo River upstream from the Jicarilla Apache Reservation. Downstream from the reservation, the Navajo Reservoir impounds water. The Jicarilla Apache Nation initially was not included as a beneficiary of either Federal water resource development project.

Settlement negotiations between the Jicarilla Apache Nation and the United States began in 1985. Central to the negotiation effort was an updated hydrology study which resulted in the Secretary of the Interior submitting to Congress a 1988 Hydrologic Determination for the Upper Colorado River Basin. According to the Hydrologic Determination, water was available within New Mexico's Upper Basin apportionment for development and settlement of the Jicarilla Apache Nation's Federal reserved water rights claims.

In October 1992, the Jicarilla Apache Tribe Water Rights Settlement Act (Settlement Act) became law (106 Stat. 2237). The water delivery provisions for future uses in the Settlement Act mandated certain requirements to be fulfilled before the water could be made available for Tribal use. All of these requirements were met, and on February 23, 1999, the Jicarilla Apache Nation water rights in the San Juan River were adjudicated in District Court, San Juan County, New Mexico.

As a result, supplying project water to the Jicarilla Apache Nation under the Settlement Act is authorized by Congress, enabling the Nation to seek delivery or to market that water under the Settlement Contract (Reclamation 2000a)[10]. Water to be supplied under the contracts with the Secretary of the Interior are of the same priority as the water rights for Navajo Reservoir and NIIP, and must share shortages with other contractors of the Navajo Reservoir Supply, including the NIIP. The Settlement Act also allows the Jicarilla Apache Nation to market water through third-party contracts, consistent with Federal and State laws. Consistent with the Settlement Act, the Department of the Interior works with the Nation to facilitate use of water pursuant to the Nation's water supply contracts with the Secretary.

[10] The Jicarilla Apache Nation has suggested that the authorized purposes of the Navajo Unit have been amended by the Settlement Act so that the Navajo Unit authorized purposes now include providing water to the Nation. While Reclamation agrees that under the terms of the Settlement Act the Secretary is authorized to provide project water to the Nation, Reclamation respectfully disagrees that the Settlement Act has created a separate and distinct project purpose. In order to create a new project purpose, the authorizing legislation for the Navajo Unit (the Colorado River Storage Project Act) must be amended. The Navajo Unit authorization, by its own terms, does not amend the CRSP: "Nothing in this Act shall be construed to alter, amend, repeal, construe, interpret, modify, or be in conflict with the provisions of . . . the Colorado River Storage Project Act. . . ." (Jicarilla Apache Tribe Water Rights Settlement Act of October 23, 1992, section 11).

Under the partial final decree in the San Juan River adjudication, the Jicarilla Apache Nation has a reserved water right for historic and existing uses not to exceed an annual diversion of 5,683 acre-feet or the quantity of water necessary to supply a depletion of 2,195 acre-feet, whichever is less, and a net evaporation of 2,187 acre-feet. These water rights retain a priority date of 1880.

In addition, the Settlement Act authorizes the Secretary of the Interior to contract with the Jicarilla Apache Nation for the delivery of 33,500 acre-feet per year with a corresponding diversion (25,500 acre-feet per year depletion) from the Navajo Reservoir supply, and 6,500 acre-feet per year of diversion (to be fully depleted from the Basin) from the San Juan-Chama Project.

A variety of development options for these water rights are being pursued by the Jicarilla Apache Nation, including third-party water leases and on-reservation water use. The Jicarilla Apache Nation has leased water to several small contractors and to the Public Service Company of New Mexico (PNM). The PNM third-party lease will put to beneficial consumptive use 16,200 acre-feet of the Jicarilla Apache Nation's Navajo Reservoir contract water beginning in 2006.

The Jicarilla Apache Nation is also pursuing use of its remaining portion of the 25,500 acre-feet of Navajo Reservoir water supply, including implementation of a proposed Jicarilla Apache Navajo River Water Development Plan that would result in the beneficial consumptive use of up to 6,000 acre-feet per year. The Nation is also investigating participation in the Navajo-Gallup Project, using 1,200 acre-feet on the Nation's Reservation and possibly contracting with the City of Gallup allowing the city to use up to 7,500 acre-feet.

Colorado Ute Tribes

The original Ute Indian reservations were carved out of the historical Ute homelands in 1868. The present lands of the Ute Mountain Ute and Southern Ute Indian Tribes are in southwestern Colorado and northwestern New Mexico. The Ute Mountain Ute lands include 890 square miles in Colorado and New Mexico. Southern Ute Indian trust lands include 470 square miles within the Tribe's 1,250 square miles of checkerboard reservation. Seven rivers in southwestern Colorado flow through the Southern Ute Indian and Ute Mountain Ute reservations. The Colorado Ute Indian Water Rights Final Settlement Agreement was signed on December 10, 1986, and quantified the Colorado Ute Tribes' water rights. The Settlement Agreement also quantified water rights of the Colorado Ute Tribes within the State of Colorado on rivers in the San Juan and Dolores Basins.

A large portion of the Settlement Act is being implemented by the Ute Mountain Utes through participation in the Dolores Project and by the Ute Mountain Ute and Southern Ute

Indian Tribes' participating in the ALP Project; however, these two projects do not fully implement the Settlement Act. The Tribes also have water rights in other rivers that do not involve the Dolores or ALP Projects, which they are presently using or have plans to use.

Methodology

Much of the ITA analysis was based on the review of documents concerning potentially impacted ITAs, with a focus on water rights. These documents included the 1986 Colorado Ute Indian Water Rights Final Settlement Agreement; the 1988 Colorado Ute Indian Water Rights Settlement Act; the Colorado Ute Indian Water Rights Settlement Act Amendments of 2000; the 1992 Jicarilla Apache Tribe Water Rights Settlement Act; Secretarial Orders 3175, 3206, and 3215; various Interior and Reclamation guidelines and procedures; available economic development, water development, and natural resource management plans for the Ute Mountain Ute and Southern Ute Indian Tribes and the Navajo and Jicarilla Apache Nations; Act of June 13, 1962 authorizing the construction, operation and maintenance (O&M) of the NIIP and the initial stage of the San Juan-Chama Project as CRSP participating projects ; and the 2000 FSEIS for the ALP Project. Correspondence between the Indian Tribes and Nations and Reclamation concerning ITAs was also reviewed.

In addition, Reclamation held meetings with Tribal representatives and their legal counsel to obtain their interpretations and assessments of ITAs that could be affected by the proposed Federal action. Information about water-related issues was obtained from the Navajo Nation's Department of Water Resources and Fish and Wildlife Department, the Jicarilla Apache Nation's Water Commission and Natural Resources Department, the Ute Mountain Ute Tribe's Planning and Development Department and Environmental Programs Department, and the Southern Ute Indian Tribe's Department of Natural Resources.

Indian Trust Assets Impacts Analysis

No Action Alternative

If no action is taken by Reclamation to operate Navajo Dam and Reservoir to meet the Flow Recommendations criteria, future Indian water development in the Basin would probably not proceed as planned, and several existing projects could be affected as well (see below). ESA consultations could be re-initiated on several existing projects such as the ALP Project, NIIP Blocks 9 through 11, and a PNM contract supplied by the Jicarilla Apache Nation. It is uncertain whether the Service would issue favorable biological opinions on these projects or any other Indian water development projects in the Basin. As discussed in the "Water Uses/Water Resources" section of this chapter, if the water supply available from Navajo Reservoir is insufficient to meet additional future water uses pursuant to Indian water rights, this could result in negative impacts to the following Tribal water development projects and Tribal water uses:

Navajo Nation.—

- ❑ NIIP (Blocks 7-11)[11]
- ❑ ALP Project -Navajo Nation Municipal Pipeline (NNMP)
- ❑ Navajo-Gallup Water Supply Project
- ❑ Rehabilitation of the Hogback Project
- ❑ Future development of Navajo Nation water rights in the Basin that have not yet been quantified

Jicarilla Apache Nation.—

- ❑ Contract to supply 16,200 acre-feet per year to PNM
- ❑ 770 acre-feet per year for small third-party water service contracts
- ❑ Navajo-Gallup Water Supply Project
- ❑ Navajo River Water Development Plan
- ❑ Other future water development to fully utilize the Jicarilla Apache Nation water rights pursuant to the Nation's contract with the Secretary of the Interior for water from the Navajo Reservoir supply.

Colorado Ute Tribes.—

- ❑ ALP Project
- ❑ Future development of up to approximately 38,000 acre-feet per year direct diversions provided for in the Colorado Ute Settlement Act that are not part of the ALP Project or Dolores Projects

Future Tribal water development and uses may be put at risk if no action is taken including the existing Florida River allocations and water from the Pine River and from Vallecito

[11] In 1991, 16,420 acre-feet per year of depletion was transferred from the Hogback Project to NIIP for ESA compliance purposes to allow construction on NIIP Blocks 1-8 to proceed while research on endangered fish recovery took place. This water would no longer be available for use on NIIP and reconsultation would need to occur.

Reservoir. Water delivery and associated contracts from Lemon and Vallecito Reservoirs could be at some risk since there have been no ESA consultations on the operations of these projects.

Other Projects.—Also at possible risk are existing Federal projects in New Mexico that have not yet undergone ESA consultation, including the San Juan-Chama Project. The Jicarilla Apache Nation has a contract allocation for water from the San Juan-Chama Project.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

The hydrology modeling results for the 250/5000 Alternative show that the Flow Recommendations could be met, including providing for all existing depletions, plus 57,100 acre-feet per year of depletion for the ALP Project and a 120,600 acre-feet per year depletion for NIIP Blocks 9-11. This would be a positive impact for the Colorado Ute Tribes and the Navajo Nation, as it fulfills requirements of the biological opinions issued for these two water development projects. This alternative also would result in a positive impact for the Jicarilla Apache Nation. It would support the delivery of 16,200 acre-feet per year to the PNM and 770 acre-feet for other small third-party water service contracts from the Nation's contract right to the Navajo Reservoir supply. The third-party water service contracts are to provide water to continue existing uses or depletions.

Potential negative impacts could include the possibility that, if no additional water development is possible, the Tribes could bear a disproportionate share of the burden to recover the endangered fish as a consequence of Tribal water rights being the last water resources to be developed in the Basin. Future water development is discussed later in this section.

Positive impacts of this the 250/5000 Alternative on future Tribal water development include:

Colorado Ute Tribes

- ❑ Depletions of 16,525 acre-feet per year each by the Ute Mountain Ute and Southern Ute Indian Tribes under the ALP Project

Navajo Nation

- ❑ Depletion of 120,600 acre-feet per year under the NIIP, Blocks 9-11
- ❑ Depletion of 2,340 acre-feet per year under the ALP Project, via the NNMP

Jicarilla Apache Nation

- ❑ Depletion of 16,200 acre-feet per year for a third-party contract to supply water to the PNM.

- ❑ Small third-party water service contracts

Although the Service may consider other factors in future ESA consultations on future water development projects (see future water development discussion in chapter II), implementation of this alternative provides the best chance to derive benefits that could include depletions for projects that currently have not undergone ESA consultation. This includes the following proposals: depletions of up to 35,893 acre-feet per year for the Navajo-Gallup Water Supply Project; depletions of approximately 16,400 acre-feet per year for rehabilitation of the Hogback Project; full use of direct diversion rights of about 38,000 acre-feet per year pursuant to the Colorado Ute Settlement; and full use of the Jicarilla Apache Nation's 25,500 acre-feet of depletions per year contract allocation from Navajo Reservoir; and possibly other Navajo Nation water uses depending on water rights negotiations or litigation.

500/5000 Alternative

If no additional water development is possible, the Tribes could bear a disproportionate share of the burden to recover the endangered fish as a consequence of senior Tribal water rights being the last water resources to be developed in the Basin.

Hydrology modeling indicates that the 500/5000 alternative would result in occasional shortages to existing and authorized water projects (including the NIIP and the ALP Project), and would at times of prolonged drought, draw Navajo Reservoir down to a level below the NIIP inlet works, and would not fully meet the Flow Recommendations criteria. The 500/5000 Alternative provides less likelihood than does the 250/5000 Alternative of being able to fully proceed with future Tribal water development.

Indian Trust Assets Economic Impacts Summary

Based on existing biological opinions, the impacts analysis in this DEIS shows that alternatives that do not meet the Flow Recommendations would negatively impact the Colorado Ute Tribes and the Navajo and Jicarilla Apache Nations (Tribes and Nations). Conversely, alternatives that meet the Flow Recommendations would have a positive impact by allowing the Tribes and Nations to develop portions of their reserved water rights and to benefit from their respective Indian water rights settlement agreements.

Depending on future biological opinions and ESA consultation, negative, long-term effects to Tribal water developments could occur with any of the alternatives, including the No Action Alternative. Future water uses under ESA would be addressed according to principles[12] developed by the SJRBRIP that explain and outline the process under which additional water projects and depletions will be evaluated:

> . . .The SJRBRIP will produce a list of actions defined in a long-range plan that can be implemented to assist in the recovery of the endangered fish. When ESA consultation is initiated on a new water depletion, the Service will determine if progress toward recovery has been sufficient for the program to serve as a reasonable and prudent alternative or measure. The Service will also consider whether the probable success of the SJRBRIP is compromised as a result of a specified depletion or the cumulative effects of depletions. The Service will assess the sufficiency of program actions in proportion to the potential impacts—that is, the smaller the impact of the action, the lower the level of actions by the SJRBRIP or others needed to avoid jeopardy and/or destruction or adverse modification of critical habitat. The Service will determine whether progress by the SJRBRIP is sufficient to provide a reasonable and prudent alternative. . ..

As stated in previous sections of this DEIS, the purpose of implementing the Flow Recommendations is to conserve the two endangered native fish species and to allow water development to continue in the Basin. Currently, ESA consultations have been completed for the following activities that include development and use of Indian water rights: 1) ALP Project, 2) NIIP (Blocks 9-11), and 3) Jicarilla Apache Nation third-party water contracts. The biological opinions issued by the Service for each of the three activities include the reoperation of Navajo Dam as a requirement to avoid jeopardy to endangered fish and thus to allow the projects to proceed.

It was outside the scope of this analysis to discuss impacts of future unidentified Tribal water development past the point of acknowledging the importance of such development, as Reclamation is only analyzing those projects that have received all necessary environmental clearance to move forward. The information needed for this analysis, such as the quantification of all water rights and associated settlements and identification of reasonably foreseeable water use plans, is not available. Negotiations on Tribal water rights and their quantification are currently under way between Tribal and Federal Governments with input from State agencies.

Under the No Action Alternative, and possibly under the 500/5000 Alternative, some existing and future major economic development would be jeopardized to an undetermined extent, and additional income and employment impacts would be expected. The economic

[12] *Principles for Conducting ESA consultations on Water Development and Water Management Activities Affecting Endangered Fish Species in the Basin*.

impacts for the ITAs do not include future non-binding or unspecified water development projects for Indian uses; however, estimated capital construction costs and some employment impacts are discussed.

The only alternative that meets the Flow Recommendations is the Preferred Alternative (250/5000 Alternative). It would positively benefit the above Tribes and Nations in the following ways:

ALP Project Construction

The positive impacts of this action are:

(1) The Colorado Ute Tribes will each receive $20 million ($40 million total) for water right acquisition or other development activities.

(2) Receive direct benefits from the expenditure of capital construction costs of over $204 million for the project.

(3) Both Tribes will be able to divert 33,050 acre feet of water per year from the Animas River (66,100 acre-feet total diversion for a 33,050 acre-feet total depletion per year). Estimated annual revenue generated from water sales could range from approximately $4,532,000 to $39,660,000.[13]

(4) The Navajo Nation would receive an annual diversion of 4,680 acre-feet from the Animas River with a corresponding depletion of 2,340 acre-feet. The estimated annual revenue generated from water sales could range from approximately $320,900 to $2,808,000.[14]

(5) A new pipeline, the NNMP as described in the ALP SFEIS. (Reclamation 2000a), is proposed to deliver municipal water (identified in item 4, above) to the following seven Navajo Nation Chapters: Shiprock, Cudei, Hogback, Nenahnezad, Upper Fruitland, San Juan, and Beclaibito. The estimated construction cost of this pipeline is $24 million, with associated income and employment benefits.

Total annual dollar benefit derived from the ALP Project to the Tribes and Nations would range from approximately $44,853,000 to $82,468,000. These values do not include capital expenditures for project construction.

---

[13] The $4,532,000 was calculated using a 2002 Colorado River Storage Project M&I rate of $68.57 per acre-foot. The upper range of $39,660,000 was calculated using a $600 per acre-foot rate which corresponds to the estimated average suburban domestic rate in the region (Navajo Nation Department of Water Resources, July 2000).

[14] The $320,900 was calculated using a 2002 Colorado River Storage Project M&I rate of $68.57 per acre-foot. The upper range of $2,808,000 was calculated using a $600 per acre-foot rate which is an estimated average suburban domestic rate in the region, (Navajo Nation Department of Water Resources, July 2000).

Navajo Indian Irrigation Project (NIIP) (Blocks 9-11)

The positive impacts of this action are:

(1) Allows for depletion of 120,600 acre-feet of water from the Basin and subsequent completion of the final three NIIP Blocks, 9 through 11. As stated in the "Socioeconomics" section of this DEIS, projected annual gross crop revenues from completion of NIIP would exceed $40 million dollars.

(2) Benefits will also be derived from the capital construction cost for project facilities (estimated at $400 million over the next 15 years) (*Water Resource Development Strategy for the Navajo Nation*, Navajo Nation Department of Water Resources, July 2000).

Total estimated annual dollar benefits derived from completion of NIIP Blocks 9 through 11 are approximately $40,259,000. This value does not include capital expenditures for project construction or additional income and jobs that may arise as a result of vertical integration (e.g., building facilities on the reservation to process NIIP agricultural products).

Water Contracts Associated with the Jicarilla Apache Nation

The positive impacts of this action are:

(1) Being able to lease a depletion of 16,200[15] acre-feet per year through a third-party contract supplying industrial water to the PNM. Beginning in 2006, this contract will generate revenue of approximately $1,110,800[16] per year for the Jicarilla Apache Nation.

(2) Providing 770 acre-feet of water through five small, third-party water service contracts. These contracts presently generate approximately $44,200[17] per year for the Jicarilla Apache Nation.

(3) Additional contracts are possible.

The total annual dollar benefit derived from the Jicarilla Apache Nation water contracts is approximately $1,155,000.

---

[15] In this instance, 16,200 acre-feet of water is diverted and 16,200 acre-feet is depleted.

[16] The $1,110,800 was calculated using a 2002 Colorado River Storage Project (CRSP) M&I water rate of $68.57 per acre-foot.

[17] The $44,200 was calculated using a 2002 CRSP M&I water rate of $68.57 per acre-foot times 560 acre-feet, and a CRSP irrigation water rate of $27.53 times 210 acre-feet.

The total estimated annual economic benefit that could be available to the Tribes and Nations from the development of the ALP Project, NIIP Blocks 9 through 11, and Jicarilla Apache Nation water service contracts, as associated with the Preferred Alternative (250/5000 Alternative), ranges from approximately $81,673,000 to $123,882,000. There is additional potential, when endangered fish are recovered, for economic development.

Under the No Action and 500/5000 Alternatives, the Navajo Nation's currently developed 65,000 acres (Blocks 1-8) of NIIP would continue to receive water service; however, Blocks 9- 11, consisting of an additional 45,630 acres, would not be developed without reconsultation under the ESA. In addition, water supply that was transferred to the NIIP from the Fruitland and Hogback Projects for completion of NIIP Blocks 7 and 8 under an earlier ESA consultation, would no longer be available. This would effectively revert the NIIP to the irrigated area of Blocks 1-6 for a total acreage of 54,500, leaving the project 56,130 acres short of full development. This would result in an estimated future loss of $40.3 million in annual gross crop revenues and eliminate more than 1,000 direct and indirect employment opportunities for the Navajo Nation.

Additionally, under the No Action and 500/5000 Alternatives, the planned development for the ALP Project would not be able to proceed without reconsultation under the ESA, negatively impacting the Southern Ute Indian and Ute Mountain Ute Tribes and the Navajo Nation. This would result in a possible loss of projected water development capital expenditures of approximately $203 million, not including construction costs of and revenue from non-binding end uses. Additional future losses to the Navajo Nation could also occur as a result of non-completion of the NNMP. Capital construction costs estimated at $24 million might not occur, along with the accompanying unquantified benefits of not providing domestic and industrial water to those chapters cited above. (Specific details and estimates for non-completion of the ALP Project and the associated impacts to the Southern Ute Indian and Ute Mountain Ute Tribes, and the Navajo Nation are in the ALP FSEIS, Reclamation (July 2000)).

The Jicarilla Apache Nation under the No Action and 500/5000 Alternatives would not be able to continue its third-party leasing of 16,200 acre-feet of water to PNM under the current ESA consultation. This contract is currently scheduled to begin in 2006, providing annual income of $1,110,800 to the Nation. The additional 770 acre-feet of water being used in unspecified contracts also falls under this same ESA consultation and might not be available along with its accompanying $44,200 of annual income.

Mitigation/ Environmental Commitments

As discussed in the introduction to this section of the DEIS, Reclamation ITA policy states that Reclamation will carry on its activities in a manner which protects ITAs and avoids

adverse impacts to ITAs when possible. When Reclamation cannot avoid adverse impacts, it will provide appropriate mitigation or compensation (Reclamation, 1994).

There are no apparent or certain mitigation measures that would guarantee avoidance of adverse impacts to Tribal water rights as a result of implementing the Preferred Alternative. However, for those proposed Tribal water development projects that may be associated with a Federal action, the required ESA consultations could result in modifications to the proposals, or in required mitigation measures, that would provide favorable biological opinions and allow the projects to proceed.

Reasonable alternatives to operating Navajo Dam to meet fully the criteria of the Flow Recommendations may be considered through ongoing and future consultation, and these alternatives may be more favorable to Tribal water development. Further, the SJRBRIP is to recommend and implement recovery activities, thus providing RPAs that are intended to allow further water development to take place in the Basin in accordance with interstate compacts and Federal trust responsibilities to the Tribes in the Basin and in compliance with the ESA.

What Reclamation can and will do is continue active participation in the SJRBRIP. The SJRBRIP is key to facilitating additional water development by the Tribes and others in the Basin. For example, successful implementation of the recovery actions by or through the SJRBRIP could lead to changing the status of the endangered species to a more favorable condition.

Positive effects are anticipated from the Preferred Alternative; any reduction in potential negative effects would depend in part on the recovery of endangered fish and on subsequent action taken by the Service. It is possible that to fully mitigate or compensate for potential negative impacts should they occur to the Tribes as a result of implementing either the No Action or any of the action alternatives, additional legislative, administrative or judicial solutions may be required.

Environmental Justice

Introduction

Executive Order 12898, dated February 11, 1994, established the requirement to address Environmental Justice concerns within the context of agency operations:

> To the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse

human health and environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States.

Upon signing the Executive order, the President also directed that all Federal agencies include environmental justice as part of the analysis associated with NEPA compliance. The Executive order on Environmental Justice requires that the responsibilities set forth shall apply equally to Native American programs. Therefore, when minority and low-income populations are discussed, Indian populations may also be included. Key indicators reviewed for Environmental Justice include income, poverty rates, and the minority population within a community. Six general principles for Environmental Justice under NEPA include:

(1) Identify minority and low-income populations in the area affected by the proposed action

(2) Consider relevant public health data and industry data regarding potential multiple and cumulative exposure of minority and low-income populations to human health or environmental hazards

(3) Recognize interrelated cultural, social, occupational, historical, or economic factors that could amplify environmental effects of the proposed action

(4) Develop effective public participation strategies that overcome linguistic, cultural, institutional, geographic and other barriers

(5) Assure meaningful community representation in the process

(6) Seek Tribal representation consistent with the government-to-government relationship between the United States and Tribal governments

Affected Environment

Within the area of effect, four low-income Tribal populations are identified: the Jicarilla Apache Nation located in northern New Mexico; the Ute Mountain Ute and Southern Ute Indian Tribes located in southwestern Colorado and northern New Mexico; and the Navajo Nation located in northwestern New Mexico, northeastern Arizona, and southeastern Utah.

Navajo Nation

The Navajo reservation, established in 1868, comprises 26,897 square miles within the States of Arizona, New Mexico, and Utah, making it the largest Indian reservation in the United

States. According to the Navajo Division of Community Development, in 1999 the population on the reservation was 172,399 and is expected to increase to nearly 500,000 by the year 2040 (Navajo Nation, 2000b). Between 1980 and 1990, the Navajo off-reservation population in New Mexico, Arizona, and Utah grew by 125 percent, and the Navajo population in the other 47 States grew by 71 percent, while the on-reservation population grew by only 22 percent.

A report from the Navajo Auditor General identifies coal mining as the single most important revenue generating source on the reservation, often producing 75 percent of the total annual general Tribal revenues. The balance of the economic base of the Navajo Nation relies on some manufacturing (artisan industry—for example, jewelry, rugs, and pottery), tourism, and government services.

In 1999 the Navajo Division of Economic Development reported that the median family income was only $11,885 while the U.S. median family income was more than $30,000. The average per capita income for the Navajo Nation was less than $6,200 while the per capita income for the State of Arizona was approximately $25,000. The Navajos have a high level of poverty, with 49 percent having incomes below the poverty level, and high unemployment rates ranging between 42 and 28 percent (Reclamation, 2000a).

The Navajo Nation faces serious water resource problems. Many homes lack indoor plumbing. More than 50 percent of Navajo homes lack complete kitchens and approximately 40 percent of Navajo households are without running tap water in their homes, relying solely on water hauling to meet daily water needs.

Many of the domestic water systems on the reservation are deteriorating, have reached maximum sustainable withdrawal capacity, and have poor water quality and/or are susceptible to drought. The Navajo Nation currently relies predominantly on groundwater to meet its needs (Navajo Nation, 2000b).

Water use on the reservation ranges between 10 and 100 gallons per capita per day (gpcd) depending on the availability and accessibility of the water supply. These figures contrast to an average per capita use for neighboring non-Indian communities in Arizona of 206 gpcd (Navajo Nation, 2000b). Based on an annual growth rate of 2.48 percent and a per capita water demand of 160 gpcd, the total annual municipal water demand on the reservation will exceed 89,000 acre-feet by the year 2040.

The Navajo Nation has completed a water development strategy to provide a safe, reliable water supply for its agriculture and M&I water supply needs, and Reclamation has agreed to assist the Navajo Nation with its water development strategy.

The City of Gallup, Navajo Nation, and Jicarilla Apache Nation, in concert with Reclamation and in coordination with the BIA have proposed a water supply system (Navajo-Gallup

Water Supply Project) that would deplete up to 35,893 acre-feet per year of San Juan River water to provide for uses in Gallup, in communities on the eastern portion of the Navajo Reservation, and the southwest area of the Jicarilla Apache Nation.

Jicarilla Apache Nation[18]

The Jicarilla Apache Nation encompasses about 1,375 square miles (880,000 acres) of land spanning the Continental Divide in northern New Mexico. The Tribal population is approximately 3,735 (Bureau of Indian Affairs, 1995). Principal elements of the economy include oil and gas production, timber, livestock production, tourism, hunting, and fishing. The Jicarilla Apache Nation has expanded their land holdings in recent years by purchasing several private ranches adjacent to the reservation, including a 32,000-acre ranch and hunting lodge near Chama, New Mexico (Jicarilla Apache Nation, 1999a).

Reservation lands extend through western Rio Arriba County, with a small southern portion in Sandoval County. The population of the two counties increased 106 percent between 1980 and 2000.

Approximately 3,800 Indian and non-Indian people live within the reservation boundaries, according to the latest Tribal census estimates. In October 1999, the Nation listed 3,305 registered members, though between 450 and 550 currently reside off the Reservation.

The percentage of the reservation population under age 18 is 45.3 percent, while 29.5 percent of the total New Mexico State population is under age 18. The percentage of the population above the age of 65 on the reservation is 2.7 percent, compared to 10.8 percent for the entire State. The ratio of females to males of the reservation population is similar to that of the entire State. The growth rate is estimated as 13.9 percent in Rio Arriba County and 16.3 percent in Sandoval County. The projections indicate an average growth rate of 1.38 percent per year and a total growth of about 40 percent over the 40-year period from 1990 to 2030.

Median household and per capita income for residents of the reservation are $25,000 and $6,600, respectively. These figures are low compared to the State of New Mexico and the two counties, while unemployment on the reservation is much higher. Unemployment on the reservation is slightly over 40 percent, compared to about 6 percent for the State. The percentage of residents below the poverty level approximates 31 percent on the reservation, compared to 20 percent for New Mexico.

[18] Information displayed is taken from the most currently available data provided by the Jicarilla Apache Nation Integrated Resource Management Plan (IRMP) Office, New Mexico Department of Commerce, 2000 Census, and information taken from the 1990 Census.

Major deficiencies exist with regard to adequate and sufficient water supplies available to residents of the Jicarilla Apache Nation. The existing municipal water system for the Town of Dulce is outdated and dilapidated, and it cannot adequately and safely serve the existing and future needs of the Jicarilla Apache Nation. It has failed to meet Federal safe drinking water standards. This lack of a reliable potable water supply impedes economic development and has detrimental effects on the quality of life and economic self-sufficiency of the Jicarilla Apache Nation. Reclamation and the Jicarilla Apache Nation have developed plans to provide a more adequate water supply (Reclamation, 2000).

Colorado Ute Tribes

Ute Mountain Ute Tribe.—The Ute Mountain Ute Reservation was formed in 1897 and is composed of more than 890 square miles (597,000 acres) in southwestern Colorado, northern New Mexico, and southeastern Utah. Ute Mountain Ute Tribal enrollment in 1997 was 1,943, with the majority of the members living on the reservation in Towaoc (population 1,343 in 1998) and the White Mesa community (population 289 in 1998). The Tribal census shows that 73 percent of members are 34 years of age or younger. Most recent employment analyses indicate a potential resident employable population of 813 people, of whom 498 are employed, leaving a current unemployment rate of 39 percent (Reclamation, 2000a).

Tribal resources include income from oil and gas wells and Tribal enterprises that revolve around tourism, including a gambling casino, an RV park, an archaeological park, and a pottery factory. The Tribe employs over 900 people in its enterprises and is a major contributor to the regional economy (Reclamation, 2000a).

Southern Ute Indian Tribe.—The Southern Ute Indian Reservation encompasses an area of more than 450 square miles (750,000 acres) in La Plata and Archuleta Counties, Colorado. Tribal headquarters are located adjacent to the town of Ignacio.

The Tribal enrollment in 1997 was 1,330, with the majority of members living on the reservation in La Plata County. The Tribal census shows that 38 percent of the membership is under 20 years of age and 76 percent is under 40 years of age. Natural resources on the reservation include extensive gas reserves, coal, timber, and water for agriculture. These resources provide the basis for the establishment of a diversified Tribal economic base. Tribal energy resources in the form of natural gas have played the largest role in the reservation economy over the past decade (93 percent of Tribal revenues in 1994 came from energy resource development) (Reclamation, 2000a).

The reservation's proximity to Durango and other tourist destinations in southwestern Colorado allows for tourism development. The reservation land includes part of the Navajo State Park, Lake Capote, and the Sky Ute Casino and Motel. The Tribe sponsors casino

gaming, cultural tours, fishing, hunting, and the Tribal Cultural Center and Museum. These enterprises play a role in diversifying the overall economy. The Southern Ute Indian Tribe employs more than 1,000 people and is a significant contributor to the regional economy (Reclamation, 2000a).

Methodology

An action that creates disproportionately high and adverse human health and environmental effects or other negative project-related impacts, such as might result from reducing available water supplies, on minority or low-income populations, would be considered significant. Also, an action which disregards the government-to-government relationship which exists between the United States and Tribes may be considered significant under Environmental Justice principles.

The principal Environmental Justice issue identified in this DEIS is the amount of dependable water supply in the Basin available to maintain existing Tribal uses and meet Tribal water development needs.

Information for the descriptions and impact assessments related to environmental justice was obtained from U.S. census records, Tribal documents and discussions with Tribal representatives.

Also, the San Juan River Basin RiverWare hydrology model was used to assess the primary Flow Recommendations criteria and to develop the secondary criteria, to analyze the effects of the ALP Project, and to analyze the effects of modifying the operating rules for Navajo Dam to mimic a natural hydrograph for the benefit of endangered fish. A more detailed model is being developed that can be used to assess the Flow Recommendations as more information is learned about the San Juan River and the endangered fish.

Impacts Analysis – Environmental Justice

Any potential adverse impacts (for example, such as could be related to the City of Gallup's domestic water supply) would be expected to be shared equally by all races and income groups. Therefore, Environmental Justice issues were analyzed in detail only for the Navajo Nation, the Jicarilla Apache Nation, and the Colorado Ute Tribes.

Economic development is critical on all four reservations in order for the Tribes to maintain their cultures and provide economic opportunities on the reservations for Tribal members. In order to have economic development occur, a safe and reliable water supply is critical. The following is a summary of how each alternative would affect the continued development of a adequate water supply for each of the Tribes.

No Action Alternative.—The No Action Alternative provides the least likelihood of any substantial future Tribal water development occurring, because further development of water from the San Juan River would be difficult to do, as Flow Recommendations would not be met and ESA compliance would be difficult to obtain. This would hinder the economic development for all four Tribes.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations).—The 250/5000 Alternative provides the best opportunity for accomplishing future Tribal water development. This alternative would avoid the greater impacts of the No Action and 500/5000 Alternatives to ITAs; it would do so by providing for some future Tribal water development while meeting flow and habitat needs of endangered fish species, thus providing for ESA compliance for further water development.

500/5000 Alternative.—The 500/5000 Alternative provides greater opportunity for future Tribal water development than the No Action Alternative, but less opportunity than the 250/5000 Alternative because Flow Recommendations would not be fully met and additional ESA consultation would be required.

AQUATIC RESOURCES

This section addresses the potential impacts to aquatic resources that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect aquatic resources?

Overview

Scope

The scope includes non-native (game and non-game fish) and native fish in both Navajo Reservoir and in the San Juan River from Navajo Dam to Lake Powell.

Summary of Impacts

Under the No Action Alternative, the reservoir fishery and the downstream tailwater trout fishery would be maintained similar to the fisheries established during operations that occurred from 1973 -91. Under this alternative, however, downstream native fish populations would be negatively impacted in a manner similar to what occurred during that time frame.

The 250/5000 Alternative would result in minor impacts to aquatic life in the reservoir. This alternative would significantly reduce trout habitat from Navajo Dam to the end of the Quality Waters section (4.4 miles below the dam). The related reduction in trout numbers within the Quality Waters would be somewhat less than the impact to habitat but nevertheless significant. Below the Quality Waters section to the Hammond Diversion the trout fishery would also be impacted by loss of physical habitat and a deterioration in water quality. Physical habitat reductions for native fishes would occur from the Hammond Diversion to the Animas River. Below the Animas River confluence, adverse effects could occur to non-native fish species while beneficial effects would occur to native fish including the federally protected Colorado pikeminnow and razorback sucker.

Assuming use of the depletions identified in the analysis of the action alternatives, the 500/5000 Alternative would have the largest impact on the reservoir fishery. However, it would maintain the existing tailwater trout fishery while having some benefits to native fish populations (e.g., flannel-mouth and bluehead sucker).

Impact Indicators

For Navajo Reservoir, failure of reproduction and recruitment of resident warmwater game fish and reduced angler catch rates would constitute indicators. For the downstream tailwater trout fishery, a long-term loss of adult trout populations and/or a reduction of usable trout habitat of greater than 20 percent would be considered an adverse impact. In addition, a reduction in trout health of greater than 20 percent associated with changes in flow would be considered a significant adverse impact. The same threshold has been assigned to impacts on native fish populations and their habitat. In addition, within the trout fishery extending to the Hammond Diversion, a deterioration of water quality conditions to the point that trout could not survive would also be an indicator.

Affected Environment

Navajo Reservoir

Game Fish.—A wide variety of game fish[19] occur in Navajo Reservoir to satisfy recreational fishing demand, including both warm and coldwater species. None of the game fish identified below are endemic to the San Juan River Basin; they were specifically introduced to Navajo Reservoir to establish a recreational fishery. Warmwater species include both smallmouth (*Micropterus dolomieu*) and largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), black crappie (*Pomoxis negromaculatus*), channel catfish (*Ictalurus punctatus*), black bullhead (*Ictalurus melas*) and northern pike (*Esox lucius*). Yellow perch (*Perca flavescens*) are also relatively common in Navajo Reservoir and have been sampled from the Piedra River upstream of Navajo Reservoir (Steve Whiteman, personal communication, 2000).[20] Coldwater species primarily include rainbow (*Onchoryhnchus mykiss*) and brown trout (*Salmo trutta*) and kokanee salmon (*Onchorhynchus nerka*).

Currently, the only fish routinely stocked in Navajo Reservoir are rainbow trout and kokanee salmon. Populations of the other species are maintained through natural reproduction and recruitment. Successful reproduction and recruitment[21] are strongly associated with seasonal reservoir drawdowns, especially during the spring and early summer. Excessive, rapid drawdowns occurring after the eggs are deposited can result in exposing the eggs to the air, causing dessication. Historically, the operation of Navajo Reservoir has varied, allowing for some years to be better game fish recruitment years than others, particularly for crappie and smallmouth bass, which are adversely affected by drawdowns more than the other species.

Drawdowns can also have an adverse impact on crayfish, the main forage base in the reservoir, especially during periods in the winter when they are dormant. Drawdowns during this time frame can expose burrows to the atmosphere leading to the dessication of the crayfish in exposed burrows. Operation of Navajo Reservoir to benefit downstream native fish populations since 1991 has better stabilized reservoir levels, benefitting warmwater fish reproduction in the reservoir. Because there are no significant populations of non-game forage fish in the reservoir, predation on other game fish by fish at higher trophic levels, such as the northern pike, is common. Bluegill, yellow perch and crappie are all preyed upon by predatory fish.

---

[19] Game fish are species of fish listed by the State as having recreational value in terms of a desire by anglers to catch them; game fish are protected by State fishing regulations.

[20] Yellow perch were either accidentally or illegally stocked in the reservoir as they have never been purposely stocked by the NMDGF.

[21] Recruitment is providing suitable habitat conditions that allow a given species to survive to reproductive age.

Nongame Fish.—Non-game fish are those fish species not specifically listed by the State as a game species and comprise both native and non-native fish species.[22]

Native Fish.—A few native fish can be found in portions of Navajo Reservoir associated with major tributaries (Pine, Piedra and San Juan Rivers.) The more common native fishes found in these areas are the flannelmouth sucker (*Catostomus latipinnis*), bluehead sucker (*C. discobolus*), and the roundtail chub (*Gila robusta*). The roundtail chub, although not federally protected, is listed as endangered by the State of New Mexico and is also protected within the Southern Ute Indian Tribal Reservation. The roundtail chub was one of the most common fishes collected from Navajo Reservoir within the first few years after the dam began filling in the mid- 1960's (Olson and McNall, 1965.) It is now rarely collected, suggesting that much of its reproductive habitat was destroyed by the reservoir.

Non-Native Fish.—Several non-native fish species occur in Navajo Reservoir or the drainages feeding it. The two most common species of non-native fishes in the reservoir are common carp (*Cyprinus carpio*) and white sucker (*Catostomus commersoni*). Both of these fishes compete with game fish and native fish for food and habitat and directly impact other fish species by feeding on their eggs.

San Juan River-Navajo Dam to Animas River

Navajo Dam to Archuleta, New Mexico.—Within this reach, non-native fishes impacted would include coldwater species such as rainbow and brown trout, and warm-water species such as common carp, mosquitofish (*Gambusia affinnis*) and fathead minnow (*Pimephales promelas*). The last three occur in a unique wetland complex immediately below the dam. Because of the cold water releases from Navajo Reservoir, native fish populations are not significant in this area.

The 6.6-mile stretch of river between the dam and Archuleta provides near optimum habitat for trout and other coldwater fish species. The State of New Mexico has designated the first 4.4 miles as the Quality Waters (also termed Special Regulation Waters) section. Below this section, sediment deposition and seasonally elevated water temperatures begin to degrade trout habitat, resulting in fewer trout as the river flows downstream.

Within the Quality Waters section, the rainbow trout population is largely maintained through the routine stocking of fingerling fish (three to four inches in length) by the New Mexico Department of Game and Fish (NMDGF), although limited successful natural

[22] Native fishes are those fish that naturally occurred within the San Juan Basin. Non-natives are those that were introduced into Navajo Reservoir either purposely or accidentally from other river drainages.

reproduction by both rainbow and brown trout has been documented. The relatively common brown trout that persist in this section of river, mostly downstream of Texas Hole (1.5 miles below Navajo Dam), are the result of natural reproduction, since they have not been stocked for several years. Rapid trout growth rates in this section of river are due to the high productivity of the deep water releases through Navajo Dam. Aquatic macroinvertebrates inhabiting this reach of river, while not overly diverse, are extremely dense, providing an excellent trout food base that results in elevated trout growth rates. (Reclamation, 1998; Sublette, 1977).

Whirling Disease was confirmed in the Quality Waters section in 1999. The presence of this parasite (*Myxobolus cerebralis*) in the system has necessitated the stocking of larger rainbow trout fingerlings (greater than five inches in total length). At this size, they are more resistant to the adverse effects of this parasite. To date, there have been no observable adverse effects within the Quality Waters section to trout due to the effects of the disease.

Archuleta to Hammond Diversion.—Downstream of Archuleta, trout habitat is reduced because of sediment deposition from numerous intermittent tributaries, water depletions caused by water diversions, and seasonally elevated water temperatures. To supplement fishing demand, the NMDGF stocks catchable-size rainbow trout at several points along the river although most stocking occurs near Archuleta. As the river nears the Hammond Diversion, 16.4 miles downstream of Navajo Dam, the fish fauna is composed primarily of native fishes, although common carp are also present. The dominant native fishes include flannelmouth and bluehead suckers, although non-natives such as the common carp can also be found.

Hammond Diversion to the Animas River.—This 27.2-mile section of river provides marginal trout habitat due to the same limiting factors described above. Changing water quality conditions favor native fish species, but population numbers are limited due to the effects of several water diversions. In addition, agricultural return flows increase in this reach, elevating salinity levels and other water quality constituents. Non-native fishes are also common within this section of river including channel catfish and common carp and to a lesser extent white sucker. Smaller non-native fishes such as fathead minnows, mosquitofish, and plains killifish (*Fundulus zebrinus*) also occur.

San Juan River-Animas River to Lake Powell

This approximate 180-mile section of the San Juan River maintains the most natural hydrologic conditions downstream of Navajo Dam, primarily due to the influence of the Animas River. This section of river includes designated critical habitat as defined under the ESA for the federally protected Colorado pikeminnow *(Ptychocheilus lucius)* and razorback

sucker *(Xyrauchen texanus)*. The Flow Recommendations were prepared to aid recovery of these endangered fishes in this section of the river. Since 1991, flows downstream of Farmington have been altered to more closely mimic a natural hydrograph. Due to the lack of adult Colorado pikeminnow and razorback sucker, a biological response from these species has not been measured (these species are discussed in more detail under the "Special Status Species" section). A program of stocking both Colorado pikeminnow and razorback suckers has been started on the river.

The relative effect of the test flows after 1991 on other native fishes, especially the bluehead and flannelmouth sucker, was not conclusive, although studies conducted under the SJRBRIP have shown that catch rates of adult native suckers have declined since 1991. This may or may not indicate these species are in decline or that changes in flow had a negative effect. Many factors could have contributed to the decline in catch rates independent of flow conditions and the habitat or other benefits provided. The roundtail chub is also known to inhabit this section of river; however, it is considered to be rare. Denser populations of roundtail chub occur in tributaries of the San Juan River below Navajo Dam primarily within the La Plata and Mancos Rivers.

Non-native species such as the channel catfish and common carp also are common within this section of the San Juan River; other smaller non-native fishes include the fathead minnows, mosquitofish and, to a lesser extent, the plains killifish. Most often these species of fish are associated with backwater and low velocity habitats. An ongoing program under the SJRBRIP within this section of river is the removal of non-native fishes, in particular channel catfish and common carp. The eventual reduction in numbers of these fishes will be beneficial to native fishes by reducing predation and indirect competition.

Additional information on the fish community of the lower San Juan River can be found in a Fish and Wildlife Service publication (Service, 2000b).

Methodology

Existing literature on the potential impact of fish species occurring in the San Juan River was reviewed, and State, Federal, and private biologists were consulted. In addition, several studies were conducted to better describe both the existing ecological and habitat conditions and the impacts associated with implementing the alternatives. When it was not possible to measure impacts, models were developed to estimate impacts to both Navajo Reservoir fluctuations and downstream flow changes. The output from these models enabled Reclamation to predict the effect various alternatives would have on warmwater fish recruitment in Navajo Reservoir and trout habitat within the Quality Waters section.

Impacts Analysis

No Action Alternative

Navajo Reservoir.— Under the No Action Alternative, the reservoir would remain at relatively higher elevations and water level fluctuations during criterial spawning times would generally be less than those of the action alternatives. During spring releases, the volume of water released would be less than predicted under either the 250/5000 or 500/5000 Alternatives. Therefore, the impact to newly deposited eggs by warmwater fish and to young-of-the-year fishes would be minimized.

San Juan River – Navajo Dam to Archuleta, New Mexico.—Base flows would be higher than 500 cfs and spring releases would be managed for longer durations but at levels more often less than 5,000 cfs (see tables II-4 and II-6 in chapter II). Trout habitat below the dam is optimized at about 1,200 cfs (VTN, 1978.) Although relatively rarely maintained at, or near, this level, flows provided downstream of the dam would generally provide more usable physical habitat than the action alternatives. Also, water quality conditions favoring coldwater fishes, especially maintaining colder water further downstream during the summer, would more often occur under this alternative.

San Juan River – Archuleta to Hammond Diversion.—Under the No Action Alternative, a minimum flow of 500 cfs would be maintained; however, excess water in the reservoir would be released over a longer period of time, resulting in flows somewhat higher than 500 cfs throughout the year. This would also result in lower-magnitude spring releases. The trout fishery would benefit from this flow pattern. Although more physical habitat would be provided for native fishes downstream of the trout fishery, colder water temperatures would likely have some adverse impact to native fish populations within this portion of the river.

San Juan River – Hammond Diversion to Animas River .—As described above, this section of river has a relatively large population of native fishes. The habitat that is provided for these native fishes, especially suckers, is considered to be an important component of the overall native fish habitat in the San Juan River. Although spring peak releases would be diminished under this alternative, higher base flows occur throughout the remainder of the year. These higher base flows would provide more available usable aquatic habitat for adult native fishes compared to the action alternatives. Few trout occur within this section of river, providing a modest fishery resource to relatively few anglers. Elevated seasonal water temperatures severely limit the extent of the trout fishery resource although this alternative would provide higher flows throughout the summer compared to the action alternatives.

San Juan River – Animas River to Lake Powell.—Trout are not a resource issue within this section of river due to water quality changes. Seasonal high water temperatures, radical flow fluctuations, and high water turbidity all combine to make this section of river undesirable for trout. Implementation of the No Action Alternative would not appreciably affect these limiting factors.

This reach includes designated critical habitat for the Colorado pikeminnow and the razorback sucker. Non-native fishes, especially channel catfish, are known to impact these two endangered fishes. Non-natives are, therefore, considered undesirable. Implementation of this alternative would likely have a more favorable effect on non-native fishes than would the action alternatives because it does not attempt to mimic a natural hydrograph in the San Juan River downstream of the Animas River. In general, native fishes do not respond favorably to radical departures from natural flow patterns, and flows modified to a more natural pattern provide less favorable conditions for non-natives.

Native fishes within this reach would likely be adversely affected by returning to the flow regime provided prior to 1991 since it does not provide a more natural flow regime.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

As discussed in chapter II, there is flexibility in summer releases under the Preferred Alternative. This would reduce impacts in the San Juan River during an interim period; however, impacts discussed below are expected to occur in the long term.

Navajo Reservoir.—Implementation of the Preferred Alternative would result in minor impacts to aquatic life in Navajo Reservoir. Impacts to the reservoir's fishery are associated with rapid drawdown, occurring in the late spring. These rapid drawdowns would impact fish reproduction by exposing their eggs to the atmosphere causing dessication. The volume of water released during controlled operations in the spring would not normally cause an increase in the incidence of egg exposure and a reduction in game fish reproductive habitat unless inflow to the reservoir was well below normal. This impact would also occur under both the No Action and 250/5000 Alternatives.

San Juan River – Navajo Dam to Archuleta, New Mexico.—For the purpose of this discussion, it is assumed that flow reductions below the current minimum flow of 500 cfs would be implemented immediately after the Record of Decision is finalized. The 250 cfs minimum release from Navajo Dam proposed under the Preferred Alternative could occur at any time of the year. The resulting impacts to the downstream aquatic resources can be described as either chronic (long term) or acute (short term). Long-term impacts

would be related to changes in physical habitat, fish health, water quality, and trout food items. Native fish are not commonly found in this segment of the river because of cold water temperatures resulting from releases from the dam.

Any reduction in flow below the current 500 cfs minimum release from Navajo Dam would result in the reduction of usable physical habitat for trout. In the Quality Waters section, average water depth would be reduced by 4 ½ inches and river surface area reduced by 5 to 10 percent when minimum releases dropped from 500 to 250 cfs. Based on the results of a trout habitat model applied that simulates available trout habitat associated with flow, it is estimated that when 500 cfs and 250 cfs flows are compared, as much as 30 percent of the adult trout habitat would be lost between the dam and Texas Hole (a 1.5-mile reach) and 37 percent of the adult trout habitat would be lost from Texas Hole to the end of the Quality Waters section near Archuleta, New Mexico (4.4 miles).[23] See table II-6 for information on the frequency of 250 cfs flows and the frequency of flows over 500 cfs for this alternative. It should be noted that reducing flows to 250 cfs in the irrigation season (March to October) might not occur until additional water development within the Basin requires it. Between the Quality Waters section and Archuleta, also known as the Regular Waters section, similar flow reductions would be expected.

The reduction in usable physical habitat would not immediately impact trout populations. A corresponding decrease in population numbers would take months or years and would most likely not be in direct proportion to the loss in habitat. For that to occur, the adult trout population impacted would need to be at, or near, carrying capacity. It is concluded that although the actual loss to the trout population would be less than the projected loss of trout habitat, this loss would still be above the 20 percent threshold considered adverse. Also, the data gathered during the 1996-97 and 2000-01 trout health assessment showed that both condition factors (length to weight ratio) and tissue lipid content were not statistically different in trout tested at the 500 cfs release as opposed to the 250 cfs release. Therefore, overall Goede trout health index did not show major differences in trout health and, in particular, these two key indices strongly support the conclusion that trout were not overly stressed during the 4-month 250 cfs winter flow test.

Other studies were initiated commencing in 1996 to assess potential impacts to the downstream aquatic community. Within this section of river, studies focused on potential effects to the tailwater trout fishery as a result of a 250 cfs dam release. Among these were a trout health assessment conducted during the 1996-97 Winter Flow Test (Winter Flow Test)

[23] Original habitat analysis is recorded in a Reclamation (1998) report. The 1998 report indicated a 24 percent reduction in trout habitat above Texas Hole and a slight increase downstream from Texas Hole when flows are reduced from 500 to 250 cfs. This analysis has been updated to better reflect habitat suitability (Valdez, 2002). The new analysis showed increased impacts on trout habitat. Reclamation believes that the new analysis more accurately reflects impacts on habitat.

which indicated that trout were not stressed from crowding resulting from habitat loss. A similar trout health assessment was completed during the winter of 2000-2001 to assess trout health associated with a 500 cfs dam release.

There were no readily discernable differences in several parameters of trout health associated with the two flows tested. This strongly indicates that trout populations associated with a 500 cfs release were, and likely continue to be, at levels less than absolute carrying capacity, meaning that trout populations were not over-crowded during the four-month 250 cfs release.

Also, during the Winter Flow Test, changes in macroinvertebrate levels were monitored and even though a 35 percent reduction in macroinvertebrate numbers was measured there was not, as stated above, significant reduction in trout condition as assessed monthly throughout the four-month test period. This would indicate that macroinvertebrate numbers were not a limiting factor within this section of river (Reclamation, 1998).

It has been documented that angling can have a significant adverse effect to trout populations. (Bouck and Ball, 1966; Schill, et al, 1986; Nuhfer and Alexander, 1992). While no site specific studies have been conducted within the San Juan River Quality Waters section, angling is believed to be the single largest source of mortality to the San Juan River trout population. It was noted and observed that during the 1996-97 and 2000-01 trout health assessments a majority of the adult trout sampled showed signs of hooking damage associated with angling. Trout in this section of the river are subjected to repeated stress as a result of catch-and-release fishing, which can result in trout mortality.

In summary, and compared to a 500 cfs release, chronic trout habitat reductions resulting from a 250 cfs release are projected to be up to 30 percent greater (above Texas Hole) and 37 percent greater (below Texas Hole); these reductions are considered to be significant adverse impacts.

The reduced available trout habitat associated with a 250 cfs release under this alternative could be potentially offset by increasing physical habitat independent of flow. This could be done by increasing pool habitats and/or placing structure in the river to increase the availability of trout habitat. The greatest opportunities for this habitat restoration work are between Navajo Dam and Texas Hole.

Acute effects to the trout fishery are associated with a rapid onset of an adverse condition that would have an immediate lethal impact. Examples are trout stranding and rapid deterioration in water quality conditions. Trout stranding was assessed in the 1996-97 Winter Flow Test and again during the Summer Low Flow Test conducted in July 2001. In neither case was it deemed a significant loss. Within this section of the river, none of the water quality parameters measured during either the winter or summer test flows exceeded

tolerance limits for trout. Based on results of the Summer Low Flow Test, it was assessed that there were no discernable acute impacts to the trout fishery associated with a 250 cfs dam release.

San Juan River – Archuleta to Hammond Diversion.—Additional flow reductions downstream of Archuleta would further reduce available physical habitat for trout. Citizens Ditch, located 1.3 miles downstream of Archuleta, may divert approximately 140 cfs. At times when releases from Navajo Dam would be reduced to 250 cfs, this could leave from approximately 60 to 150 cfs in the river downstream of the point of diversion. Although this section of river has not been modeled to provide habitat/flow relationships, visual observations indicate available physical habitat would be diminished as documented during the Summer Low Flow Test. (Reclamation, 2002).

This section of river was monitored intensively during the Summer Low Flow Test to determine whether trout stranding and water quality degradations occurred. During the Summer Low Flow Test, flows below Citizens Ditch were measured at 134 cfs, no fish stranding was observed and water quality for trout was adequate.

In the future, flows that bypass the Citizens Ditch may at times be less than the measured 134 cfs and some water quality parameters could exceed tolerance limits for trout. For example, dissolved oxygen levels, especially during night time periods, and daytime elevated water temperatures might result in conditions lethal to trout. If so, much of the trout fishery downstream of Citizens Ditch could be lost. In addition, high sediment inflow would be diluted less by the lower flows that occasionally occur in this reach.

During the irrigation season, flows below Citizens Ditch could be as low as 114 cfs.[24]. If this were to occur, the short-term potential impacts to trout within this section of river could only be mitigated by providing additional flow to offset deteriorating water quality.

Non-native, non-salmonid fish, such as common carp, mosquitofish and fathead minnows, within this section are generally considered to be an undesirable part of this ecosystem, and have an adverse effect on native fishes. Thus, any adverse impacts to these fishes are considered acceptable.

[24] The 114 cfs was derived from the difference between the diversion rights for Citizens Ditch (136 cfs) and a 250 cfs dam release. Based on information received from the New Mexico Interstate Stream Commission (NMISC), Citizens Ditch rights include the following: Bloomfield Irrigation District (106 cfs), La Pumpa Ditch (10 cfs), Jaquez Ditch (12 cfs), City of Bloomfield (4cfs), El Paso Natural Gas (2 cfs), and others (2 cfs). (Letter to Reclamation from NMISC dated March 13, 2002. Note: Information provided by NMISC and New Mexico State Engineer (table III-2) vary slightly regarding diversion rights.)

Native fishes including the bluehead and flannelmouth sucker are known to occupy this reach. It is a transitional area and their numbers are not nearly as high as in other reaches further downstream. They are considered to be highly tolerant of changing habitat availability both physically and qualitatively. It is unlikely they would be impacted by a 250 cfs release from Navajo Dam. It should also be noted that the Hammond Diversion is a physical barrier to fishes attempting to migrate upstream. Physical passage is not a flow-related issue.

San Juan River – Hammond Diversion to Animas River.—Within this reach of river, especially during summer periods, the usable habitat for trout, both quantitatively and qualitatively is degraded, both naturally and man-induced, to the point that it is not a viable fishery resource. This area would be additionally impacted by reduced dam releases to 250 cfs, but the additional resulting loss of trout habitat would not be considered adverse.

Native fishes within this area can be found in high numbers. In particular, it is considered one of the more important sections of the river in terms of percentage of native fish numbers. Water quality changes associated with reduced flows probably would not impact the native fishes present since native fishes are more tolerant of higher water temperatures and lower levels of dissolved oxygen. During the Summer Low Flow Test, sampling of an array of water quality parameters did not indicate that water quality associated with reduced flows would adversely impact natives fishes. Reduced flows and associated physical habitat loss would likely reduce native fish populations and may also impede these fishes' ability to move freely within this section of river. Under a worst-case scenario, at the upper end of this reach, summer flows as low as 60 cfs or less could occasionally be expected. For native fish populations in this reach, the only effective way to reduce impacts associated with reduced flow would be to increase flow.

The non-native, non-salmonid fish within this section are generally considered to be an undesirable part of this ecosystem and are also not overly abundant. Any impacts to these species are determined to be minimal. Their presence has both indirect and direct adverse effects on native fish species so they are considered to be undesirable.

San Juan River – Animas River to Lake Powell.—Trout are not a resource issue within this section of river due to existing water quality conditions. Implementation of the Preferred Alternative would, therefore, have no additional adverse effect on trout within this section of river

The non-native, non-salmonid fish, such as common carp and channel catfish, are commonly found throughout this section of river. This includes designated critical habitat for the Colorado pikeminnow and also includes designated critical habitat for the razorback sucker. The occurrence of several non-native fishes in this reach has both direct and

indirect impacts to these two endangered fishes and they are, therefore, considered undesirable. Implementation of the 250/5000 Alternative may have an adverse impact on some non-native fish populations, such as the common carp and red shiner, by creating physical changes in the aquatic habitat that inhibit their reproductive success. This would be associated with having a more natural hydrograph, largely provided by flows from the Animas River, that is believed to be adverse to most non-native fish species.

Other non-endangered native fish populations are also assumed to benefit in this section of river as a result of largely mimicking the natural hydrograph. Of these, flannelmouth and bluehead suckers should benefit the most of all of the non-endangered native fish present.

500/5000 Alternative

Navajo Reservoir.—Impacts to the reservoir's fishery would be greater than those described under the 250/5000 Alternative, because average water levels would be approximately 5 feet lower and fluctuations higher under 500/5000 Alternative.

San Juan River – Navajo Dam to Archuleta, New Mexico.—Under the 500/5000 Alternative, flow released from the dam would remain essentially the same as flow that has been released since 1991. Although trout habitat below the dam would not as often experience the benefits of flows between 500 and 1,000 cfs, as compared to the No Action Alternative, an excellent trout fishery would be retained for several miles below the dam. However, under certain conditions insufficient water supply may exist in Navajo Reservoir necessitating releases below 500 cfs which would have a detrimental effect to the trout fishery. These conditions include full development, use of the depletions identified in the analysis of the action alternatives, and very infrequent extended drought periods.

San Juan River – Archuleta to Hammond Diversion.—In terms of the physical habitat provided, fish populations would benefit from this alternative as opposed to how it would be operated under the Preferred Alternative due to higher flows. This benefit could be somewhat offset because of the cooler water temperatures occurring further downstream that, although not lethal to native fishes, could negatively impact natural reproduction. Nevertheless, the increase in usable physical habitat is believed to be a greater benefit than the possible adverse effects of cooler water temperatures. Therefore, this alternative, as well as the No Action Alternative, would likely have the greatest beneficial effect on native fishes and would maintain the trout fishery at present levels except during periods of prolonged reduced releases below 500 cfs, as described previously.

San Juan River – Hammond Diversion to Animas River.—Under the 500/5000 Alternative, higher minimum flows would be provided as compared to the 250/5000 Alternative. Again, compared to the 250/5000 Alternative, more physical habitat would be provided for native fishes within this reach; however, shorter-duration and less frequent spring releases would likely have some adverse impact to native fish habitat within this portion of the river. The impacts to non-native fishes within this section of river would be less than those occurring under the 250/5000 Alternative because of the higher base flows that support more usable physical habitat. Compared to the No Action Alternative, the flows would be more natural and native fish populations would be expected to benefit. This alternative and the No Action Alternative would likely have the greatest beneficial effect on native fishes within this reach.

San Juan River – Animas River to Lake Powell.— Few trout occur in this section of the river because of poor water quality. Implementation of this alternative would, therefore, have no additional effect on trout in this section of river.

Because of the high spring dam releases timed to coincide with the Animas River's peak flow, this alternative and the 250/5000 Alternative would likely have an adverse effect on the non-native fish commonly found in this section of river. Because a more natural hydrograph would be provided, native fish would benefit.

RECREATION

This section addresses the potential impacts to recreation that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect recreation?

Overview

Scope

The recreation analysis includes Navajo Reservoir and the San Juan River corridor from Navajo Dam to the Clay Hills rafting take-out area near Lake Powell in the Glen Canyon National Recreation Area.

Summary of Impacts

The No Action Alternative would have little or no impact to reservoir or river recreation. The 250/5000 Alternative would impact reservoir and river recreation. The 500/5000 Alternative would have fewer impacts on river recreation but more impacts on reservoir recreation than the 250/5000 Alternative.

Impact Indicators

Impacts were measured using various indicators, including changes in: visitor recreation experience, traditional uses (e.g., fishing, camping, and rafting), fishery habitat, and river flow levels.

Affected Environment

The study area is analyzed in four segments: (1) Navajo Reservoir, and, on the San Juan River (2) Navajo Dam to the Hammond Diversion, (3) Hammond Diversion to Montezuma Creek (Sand Island), and (4) Montezuma Creek to the Clay Hills rafting take-out.

Navajo Reservoir

About 80 percent of Navajo Reservoir and its associated lands are located in New Mexico and approximately 20 percent are in Colorado. The reservoir and lands that immediately surround it offer a variety of water-based recreation opportunities, at least half of which center on abundant fishing opportunities for a variety of fish including bass, trout, crappie, northern pike, and kokanee salmon. As the lake waters warm in summer, usage shifts to water-based sports such as water skiing. In recent years, there has been a noticeable increase in the number of family groups on summer vacation from Colorado visiting the reservoir. Other popular activities are boating, swimming, picnicking, camping, water skiing, and, to a lesser degree, hiking, wildlife viewing, and hunting.

While the United States owns all of the reservoir and lands within the reservoir boundary, recreational uses are administered primarily by the Colorado Division of Parks and Outdoor Recreation (CDPOR) and New Mexico Department of Parks and Recreation (NMDPR). The parks are open year-round with seasonal closures in some areas to conserve natural and park resources.

***Developed Recreation.*—**Developed recreation facilities currently available for public use at Navajo Reservoir include swimming beaches, marinas, boat launch facilities, camp-grounds, numerous picnic areas, and hiking trails. The recreation facilities on the Colorado side of the reservoir are currently undergoing extensive rehabilitation which should be completed by the end of 2002. Improvements include construction of a large parking lot; a new fishing access; three campgrounds totaling 110 sites; an enlarged amphitheater at the existing campground; and other, extensive improvements, including more improved campsites, more picnic sites, rental cabins, a group-use area, and new park headquarters.

***Undeveloped Recreation.*—**Concentrated use in Colorado occurs at Arboles Point and several locations along the Piedra and San Juan arms of Navajo Reservoir. The San Juan and Piedra Rivers are both popular trout fishing areas. Kokanee salmon snagging is seasonally allowed within the Navajo Recreation area. Designated roads provide easy vehicular access to parking areas near the reservoir from both the east and west sides of the Piedra arm, where day use (picnicking, fishing and hiking) and primitive camping in designated areas regularly occurs throughout the summer recreation season.

In New Mexico, dispersed use occurs at many locations, with access provided by numerous roads developed for natural gas production. In addition, the many coves of the reservoir are attractive for camping and exploring by boat. Water skiing is allowed on most of the reservoir except in some of the canyons where the channel becomes too narrow or shallow to safely ski.

***Visitation Levels.*—**Visitation to Navajo Reservoir has increased by 61 percent since 1990, an average rate of 8.6 percent per year. Visitation data in table III-4 show some variability in growth, but, overall, annual visitation to Navajo Reservoir has increased by nearly 300,000 since 1990.[25] Residents of New Mexico account for most of the visitation to the reservoir (approximately 71 percent versus Colorado's share of 29 percent). Of the 1999 total visitation of 534,099 in New Mexico, approximately 248,782 visits were recorded at the Pine River portion of the State Park, with visits along the San Juan River at 243,432, and at Sims Mesa at 41,884. Boating and camping uses on the reservoir are concentrated within a 4-month period, while the river attracts heavy use on a year-round basis.

[25] It should be noted that the numbers shown in table III-4 do not include visitors to undeveloped areas of the reservoir who pay no fees and are therefore difficult to count. An estimate of these visitor numbers, based on informal visitor counts made in 1995, is approximately 40,000 to 50,000 per year.

Figure III-3.—Navajo State Park at Arboles, Colorado.

Table III-4.—Navajo Reservoir annual visitation for Colorado and New Mexico

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CO	146,117	147,654	153,063	170,214	178,669	203,339	226,984	215,204	230,520	227,661
NM	323,277	301,463	351,638	358,348	366,805	451,409	547,041	539,444	561,016	534,099
Total	469,394	449,117	504,701	528,562	545,474	654,748	774,025	754,648	791,536	761,760

Source: CDPOR and NMSP, 1999.

Visitor Profile.—Visitor surveys in the New Mexico portion of the reservoir show that the reservoir is the primary destination for most visitors. The largest percentage of this visitor group (primary destination) originates from out of State, while the second largest includes campers over 60 years of age who are seeking developed camping opportunities. This group's average length of stay is 1 month during the warm months of May through August. During the prime season, 82 percent of respondents camp at the reservoir, while the remaining (18 percent) are day users only (Reclamation, 1999b).

Visitor Activities and Satisfaction Levels.—Fishing, swimming (which is not a sanctioned activity at most locations), picnicking, boating, and hiking/walking are popular activities in the reservoir area (figure III-4).

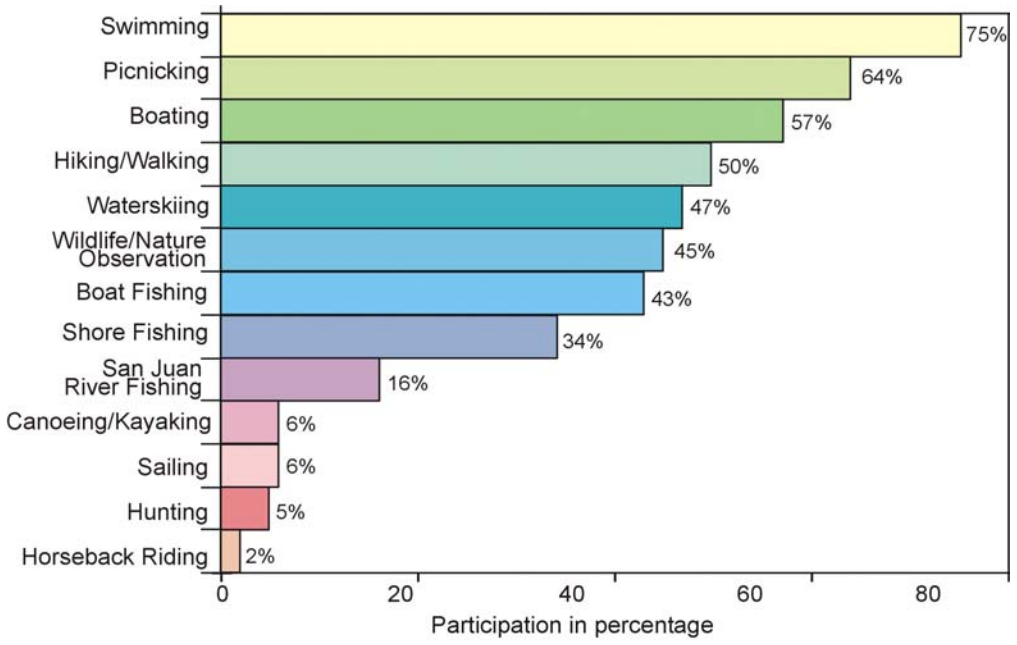


Figure III-4.—Recreational activities in the project area (Reclamation, 1999b).

Significant numbers of visitors chose dispersed camping in undeveloped areas because there were fewer people; some (a minority of 34 percent) believe that the reservoir is often crowded, and just over half (52 percent) believe it is sometimes crowded (Reclamation, 1999b).

San Juan River

Trout Fishing Area (Navajo Dam to Hammond Diversion). —Below the dam, the San Juan River area of Navajo State Park provides a recreation opportunity based on the year-round trout fishery. Hunting activities on the river are restricted to waterfowl and small game, while the surrounding areas offer opportunities such as camping, picnicking, hiking, wildlife viewing, and bird watching. Along this reach, day-use areas provide fishing access to the river, and in some cases, boating access (figure III-5).

Although tailwater trout fisheries are common below western dams, few have been as successful as the fishery below Navajo Dam. Trout grew rapidly after stocking, and, encouraged by anglers, the NMDGF began managing a portion of the tailwater as "Quality Waters," restricted to artificial flies and lures and with restricted bag and size limits. This section of the river extends 4.4 miles downstream from the dam. One angler study notes, "Most respondents came to the San Juan because it had lots of big fish and a reputation for having them" (NMDGF, 1994a). It is one of the most popular trout fisheries in the western United States, as can be attested by the visitation numbers.

No recreational boats are allowed for the first 1.5 miles below the dam and beyond that float fishing is popular. Currently, 43 outfitters and 89 guides are licensed to operate on this reach of the San Juan River. Outfitters are not limited on the number of days they can operate. Most outfitters (93 percent) that use dory boats put in at the Texas Hole Day Use Area and take out at the Gravel Pit Day Use Area at the end of the Quality Waters.

Further downstream, a very good brown and rainbow trout fishing stretch exists below Citizens Ditch[26] to the Hammond Diversion. Because the river is bounded by private lands in this area, fishing data are not available. Within the Quality Waters along the San Juan River, over half of all visitors to the river were from out of State, primarily from Texas, Colorado, Arizona, or California. Only 25 percent of visitors to the river are of local origin. Downstream from the Quality Waters, out-of-State users have made up 8 to 15 percent of users in recent years. Total angler days in the first 7.5 miles of river varied from an

[26] Citizens Ditch is 7.9 miles below Navajo Dam.

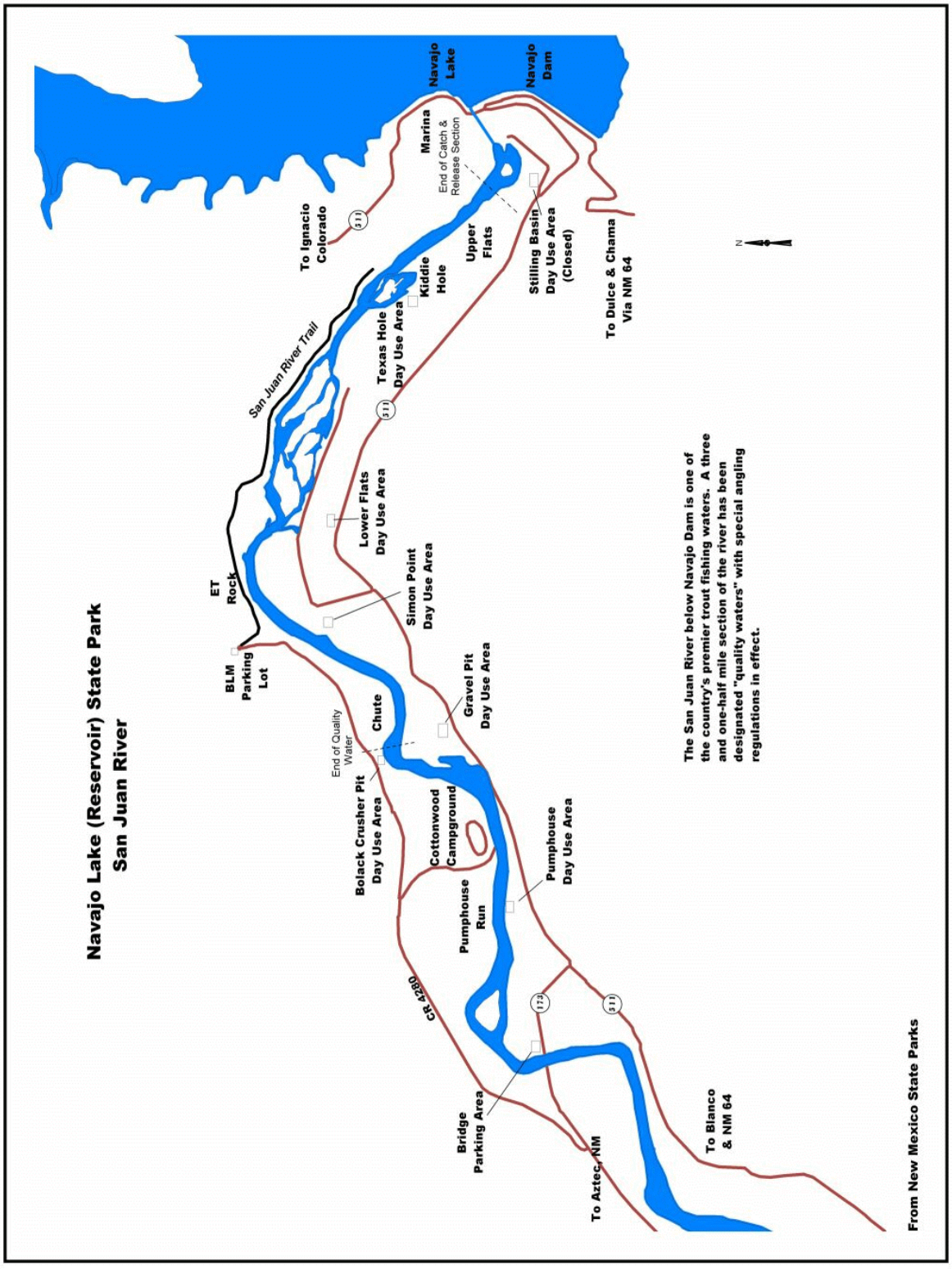


Figure III-5.—Navajo Lake (Reservoir) State Park.

estimated 44,000 to 61,000 between 1995 and 2001, and averaged 53,800[27]. The months of July through October have the highest use. Approximately 6,000 to 7,000 of these visitors use guides or outfitters[28].

A survey found that 72 percent of respondents felt the river was moderately to extremely crowded; 43 percent of the respondents indicated that they had to pass up good fishing water 50 percent or more of the time because another angler was already there (Reclamation, 1999b).

Hammond Diversion to Montezuma Creek.—Below the trout fishing area that ends at the Hammond Diversion, the San Juan River is not managed for recreation purposes by any public entity. The river is predominantly flanked by private lands to just past Farmington, where it is then bordered on the north by private lands and on the south by Navajo Nation Reservation Lands (Navajo Lands). This land ownership pattern continues for several more miles until the river is adjoined on both sides by the Navajo Lands. Recreation in this area is minimal; there is little fishing and float boating. The numerous water diversions make floating difficult and dangerous.[29]

When the river enters the Navajo Reservation, recreation management is administered by the Navajo Nation Parks and Recreation Department. Although the department does not issue rafting permits or track rafting numbers, it does issue about 450 camping and hiking permits annually for the river corridor at a cost of $5 per permit. Besides camping and hiking, these visitors also engage in catfishing. A lack of river access limits rafting in this stretch.

Montezuma Creek to Clay Hills.—The BLM has management responsibilities along the river for 104 miles from Montezuma Creek to Clay Hills in conjunction with the Navajo Nation and the National Park Service. Most rafting occurs between the Sand Island launch site near Bluff, Utah, the Mexican Hat put-in take-out site near Mexican Hat, Utah, and the Clay Hills take-out site in the Glen Canyon National Recreation Area (general locations are on the frontispiece map). The rafting access facilities at Clay Hills are affected by Lake Powell water levels and river flows. In particular, large sediment deposits and low flows can make it very difficult to access the take-out site.

[27] Communication to Reclamation from Nic Medley, NMDGF, April 18, 2002.
[28] Communication to Reclamation from Navajo State Park Superintendent, 1999.
[29] Personal communication to Reclamation from BLM, Farmington, NM, 2001.

- ❑ The Sand Island launch site is the put-in site for floats trips to Mexican Hat or Clay Hills. Use at this site consists of 11,165 users per year (48,369 total user days) for 1,225 total trips. The trips average 9.1 users per trip and 4.3 days per trip between Sand Island and Clay Hills. Maximum launches include 75 people per day or 7 groups, except for May and June when the launch maximum is 65 people per day or 5 groups, whichever comes first; this includes commercial groups.

- ❑ The site near the small community of Mexican Hat is both a put-in and take-out site. Maximum launches are 50 people per day, or 5 groups, except for May and June when the launch maximum is 50 people per day, or 3 groups; this includes commercial groups.

- ❑ The Clay Hills take-out area is remotely located and not directly accessible by any main, paved roads. Raft pick-up vehicles are normally shuttled to this site.

Launch allocations are split 40/60 between commercial and private, respectively, but actual use more closely resembles a 35/65 distribution because of outfitter cancellations and private users picking up these launch dates. The BLM has a moratorium on additional outfitters; currently, there are 11.

Commercial Rafting.—The BLM manages commercial trips by issuing permits based on historical use and allowing changes at the outfitters' request and within guidelines. At Sand Island, the commercial sector is allowed one to two launches per day. The core season for rafting companies is June, July, and August; however, there is additional use during March, April, May, September, and October.

Private Rafting.—Private rafting is managed by requiring permits all year, and about 900 permits are issued each year (approximately 4,000 applications are received). Applications are primarily selected by a lottery. August to March permits are first-come, first-served, while lottery draws fill the launch calendar from mid-April to the end of July.

Methodology

The 1999 data were used in this analysis because more current information was not available in a complete form when the analysis was conducted. In addition, it was assumed that for all alternatives, based on historical trends, there would be continued increases in fly fishing demand, continued pressure on BLM to issue more river rafting use permits during the summer, and increased reservoir recreation (about 5 to 6 percent annually).

The following criteria were used to determine the impacts to recreation from changes in the operation of Navajo Dam:

- ❑ Visitor recreation experience (angler crowding; fluctuating water levels; size and catch rate of fish)
- ❑ Visitation related to the traditional uses on the river (i.e., fishing, camping, and rafting)
- ❑ Fishery habitat changes
- ❑ River flow levels

Impacts were evaluated by developing baseline information, using the hydrologic model, modeling trout physical habitat, and extrapolating results from consequences of canceling the low flow test in 2000, the 2001 Summer Low Flow Test, and the 1996-97 Winter Flow Test.

Development of baseline information consisted of researching the local recreation resource by consulting various Federal, State, county, and city agencies, and publications; holding public and working meetings with affected permittees, groups, individuals, and cooperators; and maintaining close communication with key members of the user groups.

Summer Low Flow Test results and opinions expressed by local guides and outfitters about the effects of potential range of flows were used in an attempt to project long-term impacts on recreation resources.

Impacts Analysis

No Action Alternative

This alternative does not represent the current condition of the river; rather, it generally represents Reclamation's historical operation of the reservoir (from 1973 to 1991).

***Reservoir Recreation.*—**Generally higher reservoir levels under the No Action Alternative would be expected to result in improved conditions for reservoir recreation compared to the action alternatives, although many other variables are involved in measuring visitation.

River Recreation.—Impacts to river recreation under the No Action Alternative would be minimal. Since spring peaks would be lower and the non-peak releases would be maintained in a more uniform manner throughout the year than under the action alternatives, outfitters and other anglers would have reliable fishing conditions in the tailwater area. River conditions under this alternative would be expected to accommodate a greater increase in fishing than under the action alternatives because flows would generally be higher throughout the year.

Because average dam releases would often be twice as high as those of the action alternatives, the No Action Alternative would also maintain the water level for rafters in the Bluff area for longer periods and allow outfitters to better plan their season and reservations. However, as shown in table II-7, there would be infrequent periods of low flow (less than 500 cfs) within the rafting area when rafting would be more difficult. For example, April and September flows would be below 500 cfs approximately 12 percent of the time.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

This alternative would have a moderate impact on reservoir recreation and the greatest impact on river recreation when compared to the No Action and 500/5000 Alternatives. As discussed in chapter II, there is flexibility in summer releases under the 250/5000 Alternative. This could reduce impacts to recreation over an interim period; however, impacts discussed below are expected to occur in the long term.

Reservoir Recreation.—Average reservoir elevation reductions of approximately 10 feet would occur under the 250/5000 Alternative during the recreation season (April through October) as compared to the No Action Alternative. In dry periods this reduction could average as much as 30 feet. Lower water levels and accompanying exposure of mud flats, gravel bars, tree stumps, and rocks could adversely affect boating, fishing, and reservoir aesthetic values, especially in the Colorado portion where the waters are generally shallower. During these dry periods, the recreation facilities at Arboles, Colorado, would be impacted more than they would be impacted under the No Action Alternative, but not as much as they would be under the 500/5000 Alternative. Access to the reservoir and boat launching at Arboles marina would not be impacted since the concrete boat ramp extends to an elevation of 5,978 feet[30], which is approximately 8 feet below the top of the inactive pool.

[30] Hydrology modeling indicates that the reservoir would be drawn below 5,978 feet only once in 65 years.

Although the overall area for boating and fishing is reduced when the reservoir experiences extreme drawdown, the overall fishing catch rate normally increases at lower reservoir levels.

River Recreation.—River recreation impacts under the 250/5000 Alternative would be adverse for trout fishing (for additional details, see the "Aquatic Resources" section). Downstream rafting recreation impacts would be both positive and negative, but the overall impacts appear to be negative. Both of these river recreation impacts are discussed below.

Trout Fishing.—Table II-4 summarizes flow in the trout fishery immediately below Navajo Dam. As shown in this table, flows under the 250/5000 Alternative would range from approximately 250 to 500 cfs 70 percent of the time. These lower flows would make dory boat fishing difficult. Wade fishing is facilitated at lower flows; however, this does not mean wade fishing use would increase. Lower flows would increase conflicts between wade and boat anglers as their areas of use would overlap more during low-flow periods. Low flows would also affect the fishery itself, as discussed in the "Aquatic Resources" section.

Some outfitters may continue float fishing trips at low flows and may choose to use rubber or vinyl rafts that are able to float the river at lower flows, representing a change from the more commonly used dory boats. Flows above 1,000 cfs present problems to wade anglers because areas safely accessible are reduced; however, these conditions would occur less often under the 250/5000 Alternative.

At present, minimum dam releases are 500 cfs. At and above this level, guided float trips use dory boats, begin at the Texas Hole, and then float-fish down river to the Gravel Pit day use area. A 500 cfs flow is the approximate minimum flow at which these types of boats can successfully navigate the river without hitting the river bottom. Since it is predicted river flow would be at less than 500 cfs about 63 percent of the time during high-use months (March through November), these dories would not be able to easily float down river from Texas Hole, concentrating use at that popular location. If total angler use does not decline, recreational experience for clients and the number of guided anglers could be significantly reduced.[31] This crowding may be somewhat offset by guides acquiring and using new equipment that requires less draft, as discussed previously.

Actual fishing use depends on many factors such as catch rate, size of fish, angler crowding, economic conditions, regional human population growth, and other considerations; therefore, it is not possible to accurately predict changes in fishing use.

[31] Crowding in the special trout waters is a problem as stated in the 1994 Angler Survey. Overcrowding was identified as the most significant problem in the angler survey.

In the short term, it is anticipated that more shore or wade fishing would be substituted for a portion of the dory boat use because of navigation problems (i.e., dory boats would be scraping the bottom of the river bed). Neither the Summer Low Flow Test nor the Winter Low Flow Test showed a decrease in angler use (table III-5).

Table III-5.—Creel census and pressure counts for July 1998-2001 and the Summer Low Flow Test

	Quality Waters		Regular waters		Total	
Date	Angler hours	Catch rate per hour	Angler hours	Catch rate per hour	Angler hours	Catch rate per hour
July 2001	26,164	1.72	3,450	0.49	29,614	1.11
July 9 - 15 (Summer Low Flow Test)	4,706	2.16	1,155	0.49	5,861	1.33
July 1 - 8, 16 - 31	19,699	1.45	5,166	0.49	24,865	0.97
July 2000	21,949	1.07	7,748	1.6	29,697	1.34
July 1999	21,043	1.24	9,118	0.39	30,161	0.82
July 1998	27,674	1.23	7,459	0.39	35,133	0.81

Provided by Marc Wethington, NMDGF, and Rick Vinton, Reclamation.

Notes: (1) Angler hours for the month of July 2001 are not additive as the result of deriving full-month data based on a formula and the test weeks numbers being actual counts. (2) The low flow data were gathered daily during the 7-day test; the previous years' data for the same week was only gathered two times during the week and the weekend, so data comparisons would not be based on the same number of sampling days. (3) Comparisons can only be made on the total monthly data and the catch rates. (4) There is no real explanation why July 1998 and July 2001 angler hours are higher than July 1999 and 2000. (5) The high catch rate for the regular waters in July 2000 is due to public knowledge of the stocking date and place and the resulting catch rate (being at the right place at the right time).

In the long term, adult trout habitat reduction is assumed to result in fewer fish and this would reduce the quality of the recreation experience and perhaps angler use. The following points need to be considered when assessing impacts to angler visits:

- ❑ Trout habitat is expected to be reduced 30 to 37 percent when dam releases decline from 500 to 250 cfs
- ❑ Average river depth would be reduced by 4.5 inches and wetted perimeter by 5 to 10 percent
- ❑ Trout numbers are not expected to decline proportionally to habitat reduction, but would be reduced significantly

Figure III-6.—Spillway tailwater at Navajo Dam.

- ❑ Dam releases below 500 cfs make float fishing more difficult and may require switching from dories to rafts, and flows above 1,000 cfs make wade fishing more difficult
- ❑ Dam releases below 500 cfs make more of the river accessible to wade fishing, although overall fishable area may be reduced
- ❑ Outfitters suggest that reductions in guided dory float trips could be as much as 50 percent
- ❑ Creel census and pressure surveys conducted during the short-term Summer Low Flow Test and Winter Low Flow Test showed no reduction in angler use

It is concluded that the quality of the angler experience, particularly for people float fishing, would be reduced under the 250/5000 Alternative. Because of many variables involved, changes in actual angler numbers cannot be predicted accurately. Losses could be 5,300-plus angler days if use were directly related to changes in stream surface area or they could be 18,000 angler days if use changes were directly related to changes in trout habitat. Dory angler day losses would be a greater percentage of present use than those to wade fishing as a result of low flows.

Downstream from Citizens Ditch, negative impacts on angling would be proportionately greater because of further reduced flows. Angler use figures for this reach of the river are not available, so losses have not been projected. Long-term angler use losses downstream from Citizens Ditch could represent a very high percentage of present use because of the adverse effects to this section of the river, as discussed in the "Aquatic Resources" section.

Rafting.—The rafting community in the lower San Juan River would be adversely impacted by the low flows because higher flows create a better rafting and recreation experience. Optimum flows for rafting average 1,000 to 3,000 cfs and most commercial

rafters do not put in below 500 cfs because of safety concerns and problems with river navigation. Between 500 and 800 cfs, they use smaller boats, reducing their capacity and efficiency and increasing costs.

Outside the spring runoff season, Reclamation under the 250/5000 Alternative would maintain flows above 500 cfs downstream of Farmington. However, commercial outfitters suggest that in order for a viable rafting industry to be sustained, raftable flows above 1,000 cfs would be needed during the core season.[32] As discussed previously, minimum rafting flows are considered to be 500 cfs for the purposes of this analysis and flows above 800 cfs allow larger rafts and a higher-quality recreation experience. Table II-7 presents the percentage of time river flows would be above 500 or 800 cfs for each alternative. As can be seen from the table, flows over 800 cfs would decrease substantially, particularly in the September through March period.

The river would remain floatable throughout the recreation season under the 250/5000 Alternative because one of the Flow Recommendations criteria is to maintain flows above 500 cfs[33] for endangered fish habitat. However, because flows above 800 cfs would be reduced, a number of changes could occur in the following: the type of rafting equipment used, the quality of the recreational experience; duration of the trip; and the total number of rafters. On the other hand, flows of less than 500 cfs that would occur occasionally under the No Action Alternative would not occur as frequently under the 250/5000 Alternative, thus increasing some rafting opportunity under the latter alternative. Positive effects would occur at Clay Hills under this alternative because of more frequent and higher spring flows that flush accumulated sediments further into Lake Powell, thereby making the river more floatable. Additionally, attempts would be made to maintain flows below Bluff at 500 cfs or higher, providing higher minimum floatable flows to the Clay Hills takeout.

Overall, compared to the No Action Alternative, the 250/5000 Alternative would reduce the percentage of time when flows were above 800 cfs, increase the percentage of time when flows were between 500 and 800 cfs, and attempt to eliminate flows below 500 cfs.

500/5000 Alternative

The 500/5000 Alternative would have the greatest impact to reservoir recreation when compared to the No Action and 250/5000 Alternatives.

[32] Based on low flow test public meetings (March 2000) and conversations with commercial rafting outfitters during the 2001 Summer Low Flow Test.

[33] Because the 500 cfs minimum goal is measured as an average of gaging stations, flows may fall below 500 cfs in some reaches of the river.

Reservoir Recreation.—There would be average reservoir elevation reductions of approximately 15 feet during the recreation season (April through October) as compared to the No Action Alternative. In dry periods, this reduction could average as much as 50 feet. Lower water levels can adversely affect boating, fishing, and reservoir aesthetic values, especially in the Colorado portion where the waters are generally shallower. During these dry periods, access to the reservoir and boat launching at the Arboles, Colorado, marina would not be impacted because the concrete boat ramp extends to an elevation of 5978 feet[34], which is approximately 8 feet below the top of the inactive pool. However, the overall area for fishing is reduced when the reservoir experiences extreme drawdown.

River Recreation.—River recreation impacts would be more adverse than those under the No Action Alternative and less adverse than those under the 250/5000 Alternative.

Trout Fishing.—Maintenance of a minimum flow of 500 cfs combined with a spring peak would be expected to maintain the existing trout fishery and associated recreation. As a result, it is not anticipated that the number of anglers would be reduced and river recreation use would be expected to continue essentially unchanged, except that during very infrequent periods of severe drought, dam releases and river flows below Farmington would drop below 500 cfs.

Rafting.—When compared to the No Action Alternative, downstream rafting recreation impacts would be positive and negative. From a positive perspective, significantly more opportunities would exist for rafting at flows between 500 and 800 cfs. Conversely, flows above 800 cfs would be reduced, and experienced rafters, especially those seeking opportunities for a more challenging experience, would be impacted.

Positive effects would occur at Clay Hills under this alternative because of more frequent and higher spring flows that flush accumulated sediments further into Lake Powell, thereby making the river more floatable. Additionally, flows below Bluff would be maintained at 500 cfs or higher, providing higher minimum floatable flows to the Clay Hills takeout.

[34] Hydrology modeling indicates that that level would be exceeded only once in 64 years.

HYDROPOWER

This section addresses the potential impacts to hydropower that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect hydropower?

Overview

Scope

The hydropower resource in this analysis is the Navajo Dam Hydroelectric Plant owned by the City of Farmington (City) and operated by its nonprofit municipal electric utility to serve approximately 37,000 customers in northwest New Mexico.

Summary of Impacts

The No Action alternative would have no impact on the City hydropower generation.

The 250/5000 Alternative, along with future development of NIIP, would have a projected 10-year financial impact to the City ranging from $5.3 million to $7 million annually (based on a 10-year average loss), with a possible accompanying rate increase to customers.

The 500/5000 Alternative along with future development of NIIP would have a projected $3.2 million annual impact to the City (based on a 10-year average loss).

In addition, modification to existing equipment may be required, and/or purchasing additional replacement power from fossil fuel power plants could have negative environmental impacts under both action alternatives.

Impact Indicators

Any increases in power supply expenses, rates, equipment replacement/ modification costs, or replacement power needs as a result of changes in operation of Navajo Dam were considered adverse impacts.

Affected Environment

The Navajo Dam Hydroelectric Plant is owned and operated by the City and began full commercial operation in 1989. The City supplements its power supply with contract purchases from a mix of gas-fired, coal-fired, and hydroelectric generation to meet its energy demands that in 1999 reached 149 megawatts (MW).

The City nonprofit electric utility, a municipal entity, operates independently of the city's general fund, neither contributing to, nor relying on, the city budget for its existence.

From 1989 through 1999, the plant has averaged 135,226 megawatt hours (MWh) per year for an average output of 15.4 MW (see tables III-6 and III-7). Originally designed to take advantage of the post-dam operating criteria of constant release rates in the range of 1,000-1,200 cfs, the facility never experienced this flow regime due to dry years in the early 1990's and the commencement of the SJRBRIP endangered fish study in 1992. From 1992 until 1999, the normal release rate was constrained below 600 cfs except for the spring fish releases when the flows were increased to the 3,500-5,000 range for varying periods of time depending upon the study criteria and the runoff for that year. Normal operation for the facility during the 7-year study was, with slight variances, 600 cfs for 10 months and 3,500-5,000 cfs for 2 months. Mixed into this were various Reclamation inspections, low flow tests, and facility outages, which kept the average output in the 15-16 MW range.

Table III-6.—Navajo Power Plant annual production

Year	Annual production (MWh)	Average (MW)	FERC charges ($)
1989	131,182	15.0	184,381
1990	111,936	12.8	179,301
1991	150,336	17.2	252,536
1992[1]	166,312	19.0	252,536
1993	139,869	16.0	230,068
1994	127,938	14.6	240,974
1995	121,467	13.9	236,268
1996	140,377	16.0	220,950
1997	139,199	15.9	218,376
1998	119,539	13.6	193,738
1999	139,331	15.9	278,441
Average	135,226	15.4	226,143

[1] Abnormally wet summer; if normal, would have been 114,236 MWh, 13.06 MW (averaged).

Table III-7.—Flow versus output

Flow (cfs)	Output (MW)
200	4.0
250	5.6
300	7.5
350	8.5
400	9.5
450	12.0
500	13.5
550	15.0
600	16.0

Generally, the discharge through the plant's two turbine generating units is a function of reservoir releases determined necessary by Reclamation to satisfy downstream water rights, fish and wildlife habitat needs, flood control, and Colorado River Storage Project (CRSP) operation. However, NIIP water supply is taken directly out of the reservoir and does not pass through the power plant. Under normal conditions, all reservoir releases less than 1,320 cfs flow through the powerhouse and are used to generate power. During floods, periods of excess water, and recently, fish releases, when the reservoir release rate exceeds the discharge capacity of the generating units, the excess amount is released through the outlet works or the auxiliary outlet works.

Licenses and Other Agreements

Navajo Nation.—The City also entered into an agreement with the Navajo Nation to settle a dispute over benefits derived from the production of electric power. This agreement provided for the dismissal of any and all appeals regarding licensing, water rights, and equipment transfer by Reclamation to the City. As part of this agreement, the City agreed to and paid the Navajo Nation $2,143,998. The agreement also encompassed future rates and power delivery to the Navajo Nation.

Federal Energy Regulatory Commission (FERC).—In August, 1983, the City applied for a license under Part I of the Federal Power Act to construct, operate, and maintain Navajo Dam Hydroelectric Project No. 4720. The license was issued in October 1985 for a period of 50 years. A requirement of the permit process was an economic feasibility study based on the projected electric production versus the amount of fossil-fired generation which would have to be purchased in lieu of the project. The permit states that the project would save approximately 187,000 barrels of oil or 53,000 tons of coal per year.

The City is required to pay FERC an annual fee based on the horsepower of the generating units and the amount of water used to generate electricity. The charges from 1989 to date have averaged $226,143 per year.

Reclamation. —The City entered into a license agreement[35] with Reclamation defining property(s), responsibilities, and fees associated with construction and operation of the hydroelectric facility. One provision of the agreement states, "The Facility shall be permitted to use all flows released by Reclamation through the main outlet works to the extent of the physical capacity of the City's penstock and turbines" (item 10(e)).

Methodology

Current and projected data were obtained from plant operations and records maintained by the City and other material, including an economic study (R.W. Beck, 1985).

To assess potential facility damage from the Summer Low Flow Test, the unit was opened, inspected, and photographed in detail to note existing conditions. The unit was also inspected immediately after the Summer Low Flow Test to document any damage.

Impacts Analysis

The City currently purchases more than 43,600 MWh to meet its system energy requirements because the utility's internal resources cannot meet system demand. Because any reduction in the output of the hydroelectric units at Navajo Dam results in additional purchases to outside entities, it is possible to calculate the effect of any loss of generation from the units at Navajo Dam.

Hydropower data in Volume II show the replacement power cost analysis and MWh that would be lost under the No Action and action alternatives. The calculations are based on a 10-year forecast of replacement power costs using modeling data for anticipated average flows for the flow regimes analyzed. Two flow regimes were considered in the analysis—250 and 500 cfs minimum release rates. These flow regimes were compared to the No Action Alternative, which was also derived from hydrologic modeling data compiled from 1929 - 1993. Results show that, for the 10-year period from 2001 through 2010, the

[35] Memorandum of Understanding, March 25, 1986.

financial impact to the City would be about $53.1 million for the 250/5000 Alternative and about $31.5 million for the 500/5000 Alternative.[36] This results in an annual average range of losses from $3.2 to $5.3 million. This loss occurs primarily because of two factors: first, NIIP is assumed to be completed under the action alternatives and water diverted to NIIP does not go through the power plant; second, high spring releases require bypasses at the power plant.

Another potential major impact to the operation of the Navajo plant from the 250/5000 Alternative concerns the turbines, which may be unable to run for extended periods of time at flows lower than 350 cfs without sustaining major damage. During the 1996-1997 Winter Low Flow Test, the units experienced extreme vibration and noticeable cavitation damage. After the Summer Low Flow Test, damage noted was slight "frosting" on the leading edge of the turbine blades. No other damage was noted, but it is anticipated further damage would be associated with flows of less than 350 cfs. Because both the low-flow test periods were very short, it was not possible to determine the effect that sustained low-flow operation would have on the units. Subsequent investigation has revealed that a design modification could help to alleviate the problem. Cost for the modification and its ability to mitigate the damage is conservatively estimated at $75,000 to $100,000. If this modification were not possible or did not solve the problem, and the 250 cfs flow regime caused damage which jeopardized the integrity of the equipment, the facility might have to be taken out of service for the duration of any future low-flow period, in which case the financial impact of this alternative to the City would be about $70.4 million. This results in an annual average loss of $7 million.

During the Summer Low Flow Test, the generating unit averaged 6 MW per day, ranging from 5.7 to 6.4 MW per day. Calculations based on the unit performance curves indicated the loads should be 5.6 MW per day. The minimal variation in power production seemed to have an adverse effect on noise from the unit. The noise from the turbine runner sounded like gravel passing through the unit, and there appears to be a direct correlation with the wicket gate adjustment on the unit and the noted noise. As the wicket gates are closed to reduce the passing flows to the generating unit, the noise in the generating unit appears to increase.

[36] Power costs are based on actual proposals for replacement power received by the City in August of 2000 for the period of 2001 through 2005. The costs used in calculating the city's potential replacement cost are the least cost of all the proposals received by the City. Output corrections for flow variations are based on the manufacturers' data, using an average head of 360 feet.

Impacts Summary

No Action Alternative

The No Action Alternative, which moderates flows throughout the year, would generally benefit the City's hydropower generation. In addition, under this alternative, NIIP would not reach full development, allowing the potential release of additional water to pass through the power plant.

Action Alternatives

Changes in expenses as a result of the action alternative–such as replacement power costs to account for a shortfall in production at Navajo Dam–must be passed on to City customers. It is highly probable that the estimated replacement power costs are not representative of future power costs, if recent history is any indication[37].

Even if replacement costs remain as projected, the City may have to increase rates to cover the loss in revenue caused by the decreased output of the Navajo units. As the electric industry transitions to a deregulated market, this could result in the loss of customers by the utility, which would cause further financial hardship.

In addition, the replacement power which the City might have to purchase would come from fossil fuel generation, most likely from coal-fired power plants. Decreasing the amount of hydroelectric power produced at the Navajo Plant could result in increased air pollution and could have a negative impact on the environment.

250/5000 Alternative (Flow Recommendations) (Preferred Alternative)

As discussed in chapter II, there is flexibility in summer releases under the 250/5000 Alternative. This could reduce impacts to hydropower during an interim period; however, impacts discussed below are expected to occur in the long term. Additional long-term impacts would occur with full development of NIIP under this alternative.

This alternative operation, combined with upstream depletions by NIIP, would have a projected 10-year financial impact to the City ranging from $5.3 million to $7 million

[37] Replacement power costs during the summer of 2000 ranged from $65 per MWh to $750 per MWh, compared to the $60 per MWh used in the cost analysis contained in this report.

annually (based on a 10 year average loss), with a possible accompanying rate increase to customers. These impacts might be lessened if the City could feasibly replace equipment at the plant to enable it to more efficiently generate power at lower operating flows.

500/5000 Alternative

This alternative would have a projected 10-year financial impact to the City of $3.2 million annually (based on a 10-year average loss), with a possible accompanying rate increase to its customers. In addition, under this alternative, NIIP would not reach full development, allowing the potential release of additional water to pass through the power plant.

DIVERSION STRUCTURES

This section addresses the potential impacts to diversion structures that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect irrigation and M&I diversion structures?

Overview

Scope

The scope includes San Juan River water diversion structures downstream of Navajo Dam and other diversion structures drawing water from Navajo Reservoir.

Summary of Impacts

The No Action Alternative would have no impact to water diversion structures downstream of Navajo Dam and other diversion structures drawing water from Navajo Reservoir.

The 250/5000 Alternative might result in potentially adverse impacts to a few water users' ability to physically take water at their diversion structures downstream from Navajo Dam. Impacts to diversion structures taking water from Navajo Reservoir are not anticipated.

The 500/5000 Alternative would have no impact to water diversion structures downstream of Navajo Dam and other diversion structures drawing water from Navajo Reservoir. During extended drought periods, shortages to NIIP would occur due to reservoir water levels dropping below the NIIP inlet works.

Impact Indicators

The primary indicators for evaluating impacts included the capability of the individual diversion and intake structures to achieve their full diversion capacity during high and low flows from the San Juan River without significant damage or impairment. Adverse impacts for high flow releases from Navajo Dam (up to 5,000 cfs) are those requiring diversion structure managers to undertake repairs to flow-damaged diversion structures. Adverse impacts occur when diversions of legal entitlements cannot be made due to physical constraints of the diversion mechanism at flows less than 500 cfs. Such impacts may result in the need to alter the river channel or the diversion structures in order to receive water from the San Juan River.

Affected Environment

The existing San Juan River water diversion structures downstream of Navajo Dam, and other diversion structures drawing water from Navajo Reservoir, include the following: (main diversions are shown on accompanying figure III-7).

Navajo Reservoir Water Diversions

(1) Navajo Indian Irrigation Project (NIIP) headgate
(2) Various New Mexico State Parks pump intakes

San Juan River Water Diversions (Downstream of Navajo Dam to Animas River Confluence)

(1) New Mexico State Parks Cottonwood Campground (Streambed Intake Gallery)
(2) Navajo Dam Water Users Association (Streambed Intake Gallery)
(3) Citizens Ditch– includes diversions for Bloomfield Irrigation District, Jaquez Ditch, La Acequia de la Pumpa, City of Bloomfield, Lee Acres, El Paso Natural Gas, Conoco, Morningstar, and Plateau (Note: City of Bloomfield currently diverts water from the Citizens Ditch but is designing a direct diversion from the San Juan River)

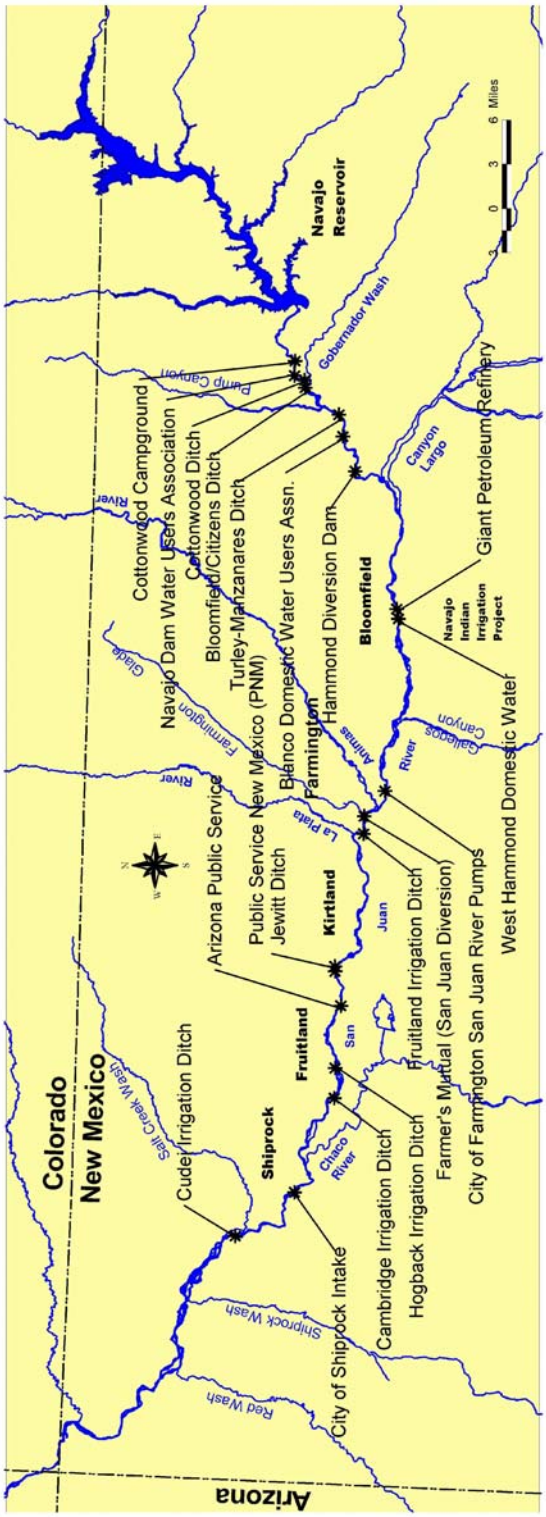


Figure III-7.—Primary water diversions downstream from Navajo Reservoir.

(4) Cottonwood Ditch (old Archuleta Ditch area)
(5) Turley-Manzanares Ditch
(6) Blanco Domestic Water Users Association (Streambed Intake Gallery)
(7) Hammond Conservancy District Canal
(8) Giant Refinery - (flow-through channel and pump diversion from the San Juan River)
(9) West Hammond Domestic Water Users Association
Lees Acres Water Users Association (receives water from the West Hammond Water Users Association)
(10) Williams Field Service (pump diversion from the San Juan River)
(11) City of Farmington - (usually diverts from the Animas River but has a pumping plant on the San Juan River for use during droughts)

San Juan River Water Diversions (Downstream of the San Juan-Animas Rivers Confluence)

(12) Lower Valley Water Users - (currently divert water from the Farmers Mutual Ditch but have the right to divert directly from the San Juan River)
(13) Farmers Mutual Ditch - (usually diverts from the Animas River but also has the right to divert from the San Juan River)
(14) Fruitland Irrigation Project Canal (Navajo Nation/BIA)
(15) Public Service Company of New Mexico - San Juan Generating Plant Intake
(16) Jewitt Valley Ditch
(17) Arizona Public Service Company - Four Corners Generating Plant Intake
(18) Hogback Irrigation Project Canal (Navajo Nation/BIA– now includes diversions for both the Hogback and Cudei Projects)
(19) Cambridge Ditch (Navajo Nation/BIA)
(20) Shiprock Municipal Water (diverts water via pumps)
(21) Numerous pump intakes in Utah

Methodology

Any short- or long-term, direct or indirect, or cumulative impacts were evaluated by:

- ❑ Interviewing the reservoir superintendent, Reclamation O&M staff, and water users.

- ❑ Examining the hydrologic release pattern for each alternative with special emphasis on the effect each has on reservoir levels and river flows, and comparing the proposed releases to historical reservoir and dam flow release records.

- ❑ Reclamation personnel visited each of the known river and reservoir diversion structures during periods of high flows (5,000 cfs) in June 2000 and during the Summer Low Flow Test conducted in July 2001.

- ❑ Reclamation and Corps personnel visited selected river diversion structures and met with the representatives of entities operating the diversions in September 2000 to discuss the sections of the Clean Water Act (CWA) (Section 404) that affect diversion structures, the authority for enforcing the appropriate sections of the CWA, and the latest interpretations of those sections.

Impacts Analysis

No Action Alternative

Diversion structures would benefit from more moderate flows under the No Action Alternative, and there would be essentially no adverse impacts.

Impacts of various flow release levels are shown in table III-8.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

As discussed in chapter II, flexibility is anticipated in irrigation season releases under the 250/5000 Alternative. This could reduce any impacts during an interim period; however, impacts discussed below are expected to occur in the long term.

Analysis shows that releases lower than 500 cfs, under this alternative, would be experienced for up to 3 months in the summer and most of the winter of any given year. A few river diversion structures below the dam would experience impacts from this alternative, most significantly in the reach of the San Juan River from Navajo Dam to the confluence of the Animas River in Farmington. The main impact to a few of the diversion structures is that low river flows might make it difficult to divert water to their systems without some modifications to the river channel or to the structures.

Impacts associated with springtime and possible fall peak releases of up to 5,000 cfs under this alternative include damage to diversion structures. Such damage usually requires the irrigators to rework the river channel near the head of the ditch in order to get water into the ditch after the peak releases are completed and base flow releases resume.

Increased coordination among Reclamation, various water user entities, and local, State, and Federal agencies and emergency organizations would be required when periods of high

Cottonwood Diversion and intake gallery.

Bloomfield - Citizens Diversion and wasteway.

Navajo Dam Water Users Association intake gallery

Turley-Manzanares Diversion.

Table III-8.—Summary of annual impacts on the operation and performance of the San Juan River and Navajo Reservoir water diversion structures and water user entities from high or low releases

Diversion name	Release level	Impacts and potential remedies (K = $1,000)
New Mexico State Parks Cottonwood Campground (water well)	High flow (5,000 cfs)	None – should not affect structure's ability to divert
	Low flow (500 cfs)	None - should not affect structure's ability to divert
	Low flow (250 cfs)	May affect structure's ability to divert Intake gallery and well may need to be modified -$2K
Cottonwood Ditch Streambed Intake Gallery	High flow (5,000 cfs)	None – should not affect structure's ability to divert
	Low flow (500 cfs)	None – should not affect structure's ability to divert
	Low flow (250 cfs)	None – should not affect structure's ability to divert
Citizens Ditch Rock Weir and Diversion Intake Channel[1]	High flow (5,000 cfs)	Diversion channel overflow cuts needed before and rock weir repairs necessary after flows at 5000 cfs or above Cost - $2K
	Low flow (500 cfs)	None - should not affect structure's ability to divert
	Low flow (250 cfs)	Rock weir embankment in river channel is needed – cost $1.5K.
Navajo Dam Water Users Association Intake Gallery[2]	High flow (5,000 cfs)	None – should not affect structure's ability to divert
	Low flow (500 cfs)	None - should not affect structure's ability to divert
	Low flow (250 cfs)	River channel modification is needed – cost $1K
Turley-Manzanares Rock Weir and Diversion Intake Channel[1]	High flow (5,000 cfs)	Diversion channel overflow cuts needed before and rock weir repairs necessary after flows at 5,000 cfs or above – cost $2K
	Low flow (500 cfs)	Rock weir embankment in river channel is needed – cost $1.5K
	Low flow (250 cfs)	Rock weir embankment in river channel is needed – cost $1.5K
Hammond Project Diversion Dam[1]	High flow (5,000 cfs)	None – should not affect structure's ability to divert
	Low flow (500 cfs)	None – should not affect structure's ability to divert
	Low flow (250 cfs)	None – should not affect structure's ability to divert

Table III-8.—Summary of annual impacts on the operation and performance of the San Juan River and Navajo Reservoir water diversion structures and water user entities from high or low releases (continued)

Diversion name	Release level	Impacts and potential remedies
Williams Field Service Pump Intake	High flow (5,000 cfs)	None – should not affect structure's ability to divert
	Low flow (500 cfs)	None – should not affect structure's ability to divert
	Low flow (250 cfs)	River channel modification needed – cost $1.5K
West Hammond Domestic Water Users Association Rock Weir and Diversion Intake[2]	High flow (5,000 cfs)	None – should not affect structure's ability to divert
	Low flow (500 cfs)	None – should not affect structure's ability to divert
	Low flow (250 cfs)	River channel modification and rock weir embankment is needed – cost $1.5K
Giant Refinery Flow-Through Channel and Pump[2]	High flow (5,000 cfs)	None – should not affect structure's ability to divert
	Low flow (500 cfs)	None – should not affect structure's ability to divert
	Low flow (250 cfs)	River channel modification and rock weir embankment is needed – cost $1.5K
City of Farmington Municipal San Juan River Pump Intake[2]	High flow (5,000 cfs)	None – should not affect structure's ability to divert
	Low flow (500 cfs)	None – should not affect structure's ability to divert
	Low flow (250 cfs)	River channel modification and rock weir embankment is needed – cost $1.5K
Summary of costs to all diversion entities	High flow (5,000 cfs)	Cost – $4K
	Low flow (500 cfs)	Cost – $3K
	Low flow (250 cfs)	Cost – $12K
Summary of total costs to all diversion entities for alternatives	500/5000 Alternative	Cost – $7K
	250/5000 Alternative	Cost – $16K

Note: Costs would apply for each instance when action is needed.
[1] Section 404 permit not required for construction work in river channel within immediate vicinity of diversion structure.
[2] Section 404 permit required for construction work in river channel within immediate vicinity of diversion structure. File with Albuquerque Corps of Engineers office.

downstream tributary flows were experienced simultaneously with high-flow dam releases under all hydrologic alternatives being considered. High flow releases from the dam might have to be curtailed at such times to safely allow passage of these high downstream inflows. Maximum safe channel capacity in the reach of the San Juan River from Navajo Dam to the confluence of the Animas River in Farmington is 5,000 cfs.

The irrigation diversion structures which sustain damage from high flows could be repaired without obtaining a CWA Section 404 permit. Owners of domestic or M&I river intake or diversion structures which sustain damage would be required to file for a Section 404 permit, as applicable, with the Corps.

The managers of irrigation diversion structures unable to receive water from the San Juan River during low flows would be allowed under terms of the CWA, Section 404, to alter the river channel in the immediate vicinity of the diversion structure in order to receive water to it. Managers of domestic or M&I river intake or diversion structures unable to receive water from the San Juan River during low flows would be required to file for a Section 404 permit with the Corps.

500/5000 Alternative

There would be some impacts to water diversions under the 500/5000 Alternative. During extended droughts, low reservoir water elevations would interfere with water supplies for NIIP. Based on hydrologic modeling, this occurred one year in 65. In relation to the 500 cfs minimum release rate, no impacts would be expected to diversion structures, and, overall, only secondary, short-term effects would be expected to occur to diversion structures in the San Juan River.

High-flow impacts under this alternative would be similar to those under the 250/5000 Alternative.

Technical Assistance

Reclamation has offered to look at the effects of high and low flows under its Technical Assistance to the States Program. To date, Reclamation has completed a preliminary design for an intake structure for the Turley-Manzanares Ditch Company to alleviate the problems associated with high flows. If requested by the State of New Mexico, Reclamation will further investigate the severity of impacts associated with high and low flows. Funding of the structural modifications will be the responsibility of the owners of the intake or diversion structures.

Monitoring

During low flows, increased monitoring by Reclamation of river gaging stations and at other critical points along the river downstream of the dam would have to be carried out. The State of New Mexico is responsible for administering water rights in New Mexico.

Reclamation will work with other responsible agencies to pursue installation of additional remote weather monitoring equipment at key sites within tributary drainages to support the gathering of critical downstream tributary flow data that assists operational decision making. Such decisions would need to be made when periods of high downstream tributary flows were experienced simultaneously with high dam releases.

WATER QUALITY

This section addresses the potential impacts to water quality that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect water quality and the attainment of water quality standards?

Overview

Scope

The scope includes Navajo Reservoir and the San Juan River to Lake Powell.

Summary of Impacts

Under the No Action Alternative, existing trends of water quality degradation would be expected to continue in the San Juan River below Navajo Dam.

Under the action alternatives, the increased spring releases would lower concentrations of contaminants in the San Juan River because of dilution; lower releases under the 250/5000 Alternative during the rest of the year would increase concentrations, and exceedences of water quality standards could also potentially increase. Lower flows could affect discharge permits (i.e., for the Bloomfield wastewater treatment plant).

Impact Indicators

Exceedences of Federal, State, and Tribal water quality standards were considered an adverse impact.

Affected Environment

The San Juan River is characterized by good water quality when flows are released from Navajo Dam, but water quality progressively degrades downstream due to natural and induced bank erosion, diversions, agricultural and municipal use, and tributary contributions. The State of New Mexico has listed reaches of the San Juan River where water quality does not meet intended uses. Turbidity, fecal coliform, and bottom sediments impact the designated uses of the river most often. Several trace elements (selenium, aluminum, arsenic, mercury, copper, and zinc) have occasionally exceeded State standards from Navajo Dam to Farmington, New Mexico (Reclamation, 2000a).

San Juan River water quality generally declines to Shiprock, New Mexico, with the stretch of the river between Farmington and Shiprock having the highest number of water quality standard exceedences. At the Four Corners gage/sampling site, water quality improves and the number of exceedences decreases, but water quality declines again from Four Corners to Mexican Hat, Utah (Reclamation, 2000a).

The State of New Mexico has issued fish consumption advisories because of elevated mercury concentrations in fish for Navajo Reservoir and the San Juan River from Hammond Diversion to the mouth of the Mancos River.

A number of facilities (city wastewater treatment plants and power plants) have National Pollution Discharge Elimination System (NPDES) discharge permits along the San Juan River. These permits are based on critical low-flow values determined from flow in the river where they discharge.

Previous Water Quality Studies[38]

Studies used in analyzing water quality impacts included extensive water quality studies that have been conducted on the San Juan River and its tributaries within the last 10 years.

[38] The discussion is a brief summary of the detailed results produced by the studies in question. The summaries are general in nature, and the reports should be read for detailed analysis of the findings.

The U.S. Geological Survey (GS) has conducted studies under the Department of the Interior's National Irrigation Water Quality Project (Blanchard et al., 1993; Thomas et al., 1998). The SJRBRIP was initiated in October 1991 and has been collecting data on water quality on the San Juan River ever since. In addition, water quality data were collected and analyzed as part of the NIIP environmental studies on the San Juan River mainstem as well as on tributaries, seeps, springs, ponds, and wells on the project lands. Table III-9 is a summary of historical water quality data collected on the San Juan River at the GS gaging stations. Figure III-1 (at the beginning of chapter III) shows the location of GS gages and water sampling sites on the San Juan River.

The early GS investigations (Blanchard et al., 1993) were reconnaissance-level studies to identify whether irrigation drainage: (1) has caused or had the potential to cause adverse harmful effects to human health, fish, and wildlife; or (2) may adversely affect the suitability of water for other beneficial uses in the Basin. It concluded that selenium was the major trace element of concern in all sampled media (water, bottom sediments, and biota). The GS performed a detailed study of selenium and selected constituents in water, bottom sediments, soil, and biota associated with irrigation drainage in the San Juan River area (Thomas et al., 1998). Selenium was much less concentrated in water samples than in bottom sediment, soil, or biota samples. Mean selenium concentrations in water samples were greatest from seeps and tributaries draining irrigated lands; less concentrated at irrigation-drainage sites and ponds on irrigated land; and least concentrated at irrigation-supply sites, in backwater, and at San Juan River sites. Other elevated trace elements in water, bottom sediments, soils, or biota included lead, molybdenum, strontium, zinc, vanadium, barium, cadmium, chromium, iron, mercury, and aluminum.

The NIIP biological assessment (Bureau of Indian Affairs, 1999) assessed the impacts from full development of NIIP. The "Water Quality Analysis" section concluded that the project will increase arsenic, copper, selenium, and zinc levels in the San Juan River. It was concluded that levels of arsenic and zinc concentrations would be below levels of concern for the two endangered fish species. Conclusions on copper were less certain but are not expected to impact the two endangered fish species. Selenium received a low hazard potential, but uncertainty about actual levels in biota downstream from the project and chronic toxicity to razorback sucker leaves the possibility of some impact to the recovery of the species. The Navajo Nation developed water quality regulations in 1999[39]. The predicted arsenic, copper, selenium, and zinc levels in the biological assessment are below the Navajo Nation water quality standards. The predicted dissolved selenium level is 1.9 µg/L, while the standard for total selenium is 2.0 µg/L in the San Juan River. The NIIP biological assessment assumed that the minimum release rate from Navajo Reservoir would be 250 cfs in the future.

[39] The Navajo Nation Water Quality Standards are awaiting Environmental Protection Agency approval.

Table III-9.—Historical (1950-1998) water quality measurements on the San Juan River

	Farmington		Shiprock		Four Corners		Bluff	
Parameter	n	Mean	n	Mean	n	Mean	n	Mean
Alkalinity total (mg/L as $CaCO_3$)	607	114	646	119	59	121	2,333	147
Aluminum dissolved (µg/L as Al)	34	34.4	138	58.5	40	63.9	174	64.1
Aluminum total (µg/l as Al)	30	5,283	83	15,636	30	11,373	134	20,500
Arsenic dissolved (µg/L as As)	76	1.9	267	2.3	78	1.8	345	1.9
Arsenic total (µg/L as As)	78	2.8	224	4.4	72	3.8	309	4.3
Boron dissolved (µg/L as B)	315	49.5	678	103.9	45	126.0	1,720	68.7
Cadmium dissolved (µg/L as Cd)	11	0.8	71	0.9	15	1.2	56	1.0
Cadmium total (µg/L as Cd)	12	5.7	29	3.6	7	3.7	15	3.7
Calcium dissolved (mg/L as Ca)	859	61.6	1,178	72.4	135	65.6	2,627	93.8
Calcium total (mg/L as Ca)	5	71.5	12	70.8	6	78.8	23	88.8
Chloride total in water (mg/L)	830	9.8	1,084	16.9	104	13.5	2,568	20.6
Chromium dissolved (µg/L as Cr)	4	11.3	53	3.2	4	2.9	48	2.5
Chromium total (µg/L as Cr)	9	51.8	25	22.5	5	17.0	17	52.1
Cobalt dissolved (µg/L as Co)	9	1.5	67	1.4	10	1.6	53	1.5
Cobalt total (µg/L as Co)	13	44.4	29	22.9	7	10.6	21	41.7
Copper dissolved (µg/L as Cu)	45	3.8	165	4.2	48	5.0	203	4.9
Copper total (µg/L as Cu)	45	29.5	121	35.5	42	20.8	163	35.8
Fecal coliform (counts/100 mL)	93	10,588	162	1,040	23	256	72	185
Hardness calc. (mg/L as $CaCO_3$)	859	189	1,154	237	123	222	2589	326
Hardness total (mg/L as $CaCO_3$)	824	189	969	245	45	224	2423	336
Iron dissolved (µg/L as Fe)	164	47.2	251	31.2	42	22.0	69	30.5
Iron total (µg/L as Fe)	15	25,691	39	30,449	13	13,405	201	4,809
Lead dissolved (µg/L as Pb)	67	0.7	256	1.5	70	0.8	343	1.0
Lead total (µg/L as Pb)	79	30.3	222	27.6	71	23.6	305	26.1
Magnesium dissolved (mg/L as Mg)	859	8.4	1,176	13.4	135	14.4	2,628	25.0
Magnesium total (mg/L as Mg)	5	11.9	12	14.0	6	17.4	23	27.1
Manganese dissolved (µg/L as Mn)	26	22.3	110	45.0	30	6.3	86	6.1
Manganese total (µg/L as Mn)	20	852	56	978	27	449	39	1,109
Mercury dissolved (µg/L as Hg)	70	0.12	254	0.13	75	0.10	338	0.11
Mercury total (µg/L as Hg)	78	0.14	225	0.15	71	0.13	309	0.14

Table III-9.—Historical (1950-1998) water quality measurements on the San Juan River (continued)

Parameter	Farmington		Shiprock		Four Corners		Bluff	
	n	Mean	n	Mean	n	Mean	n	Mean
Nickel dissolved (µg/L as Ni)	28	6.1	146	4.6	36	5.2	184	4.6
Nickel total (µg/L as Ni)	28	6.8	105	12.1	39	9.7	144	15.5
Nitrite + nitrate total (mg/L as N)	47	0.27	98	0.39	27	0.74	55	0.78
Oxygen dissolved (mg/L)	251	9.5	455	9.8	159	9.5	478	9.2
pH lab (standard units)	879	7.81	1,097	7.89	107	8.25	1,357	7.78
pH field (standard units)	60	8.13	190	8.26	60	8.25	285	8.20
Phosphorus total (mg/L as P)	59	0.27	164	0.32	31	0.37	95	0.58
Residue total filtrable (dried at 180° C) (mg/L)	374	382	667	498	102	422	1,313	656
Selenium dissolved (µg/L as Se)	81	0.6	277	1.0	78	1.3	349	1.1
Selenium total (µg/L as Se)	76	0.7	227	0.9	71	1.6	309	1.4
Selenium total recoverable (µg/L as Se)	10	0.5	29	1.0	10	0.9	47	0.8
Silver dissolved (µg/L as Ag)	2	0.75	51	0.56	n/a	n/a	45	0.56
Silver total (µg/L as Ag)	2	0.75	10	1.10	n/a	n/a	9	2.06
Sodium dissolved (mg/L as Na)	836	44.7	951	64.6	112	49.3	2,047	79.2
Sodium total (mg/L as Na)	5	37.7	12	38.5	6	43.8	23	58.2
Solids susp.-residue on evap. at 180 °C (mg/L)	59	242	191	956	60	663	283	934
Specific conductance (µmhos/cm @ 25 ° C)	905	550	1136	716	112	644	2,020	931
Sulfate total (mg/L as SO_4)	827	154	1,083	225	104	193	2,568	329
Turbidity (NTU, FTU, JTU)	117	158	142	527	104	406	92	503
Water temperature (°C)	60	10.6	227	12.2	79	12.4	343	12.6
Zinc dissolved (µg/L as Zn)	80	9.2	268	9.2	77	7.8	346	15.7
Zinc total (µg/L as Zn)	75	92.9	224	114.1	71	204.0	306	109.6

Source: Final Supplemental Environmental Impact Statement, Animas-La Plata Project, Technical Appendices, Water Quality Analysis (Reclamation, 2000a).

The SJRBRIP study on environmental contaminants in aquatic plants, invertebrates, and fishes of the San Juan River mainstem was completed in 1999. The trace elements evaluated included aluminum, arsenic, copper, selenium, and zinc. Aluminum appeared to be related to sediment geochemistry, and most life forms associated with sediment had elevated levels. Arsenic levels showed no consistent pattern for any river reach or site. Elevated arsenic levels were found in most plants and some invertebrates and fish. Elevated copper levels were found in the trout from upstream coldwater river reaches. Generally, copper concentrations in plants, invertebrates, and fish increased downstream from the coldwater areas. Selenium concentrations were clearly elevated in all biota above ambient background concentrations. Zinc concentrations in plants, invertebrates, and fish below Farmington to the "Mixer area" (RM 135)[40] were generally higher than the rest of the river, and it appears the source may be the Animas River. The study found no consistent correlation between contaminant concentrations and river discharges.

As identified in the ALP Project FSEIS, a number of water quality standards are periodically exceeded in the San Juan River in New Mexico and Utah (Reclamation, 2000a). Above Farmington, New Mexico, there are a few historical exceedences in the San Juan River for aluminum, mercury, selenium, cadmium, and lead. Exceedences increased between Farmington and Shiprock, New Mexico, including several for copper and zinc. At Four Corners, New Mexico, exceedences decrease and then increase again at Mexican Hat, Utah. According to Utah regulations, there are exceedences in nutrients and TDS.

The FSEIS also reports: "These historic values could be slightly affected by the operation of Navajo Dam for endangered fish." The increase in spring runoff flows will result in improvement of water quality during the runoff period, but the lower flows during the rest of the year will provide less dilution and may impact the water quality of the San Juan River. Monitoring over the last 7 years of modified flows (reflects 500/5000 Alternative due to releases above 500 cfs) has not detected a measurable change in water quality.

Methodology

Impacts were evaluated by the following measures:

- ❑ Researching the existing water quality standards from the three States (Colorado, New Mexico, and Utah) and three Indian reservations (Southern Ute Indian, Navajo Nation, and Ute Mountain Ute) and identifying differences between them for reservoir and river segments of the San Juan River.

[40] The "Mixer area" is a suspected Colorado pikeminnow spawning site.

- ❑ Researching available water quality reports and assessments to determine possible impacts to the San Juan River from changes in the operation of Navajo Reservoir.

- ❑ Examining and comparing the hydrologic model output for each alternative to historical flows to determine possible variations in flow from the future operation of Navajo Reservoir.

- ❑ Evaluating the expected impacts on water quality against the water quality standards.

Water Quality Standards

State and Tribal water quality standards have been developed and applied on the San Juan River from the three States (Colorado, New Mexico, and Utah) and three Indian reservations (Southern Ute Indian and Ute Mountain Ute Tribes, and the Navajo Nation) through which it flows. The States and Tribes have developed numeric and narrative standards for streams, rivers, and lakes within their boundaries. The Ute Mountain Ute Tribe is in the process of developing draft water quality standards and getting approval by the Environmental Protection Agency (EPA). The Southern Ute Indian Tribe adopted standards in 1997 for their reservation. The Southern Ute Reservation has sections of non-Indian land throughout, and the Tribal water quality standards presently apply only to reservation land owned by the Tribe within the reservation boundary.[41] The Navajo Nation adopted water quality standards for their reservation in 1999.

Regulators usually assess impacts to the surface water quality by looking at the exceedences of numeric standards. For the most part fishery aquatic standards are divided into chronic and acute standards based on exposure time that the aquatic organisms experience. There are also narrative standards which have no numeric values which regulate some physical attributes (i.e. color, odor, taste of fish, etc.). The chronic standard is often expressed as a four-day average and the acute standard as a one-hour average or single sample. Few water quality measurements are done this way. Most data is collected as a single sample and entered into a database as such. Exceedences for this DEIS are based on comparing the single sample result to the chronic and acute standards as was done in the ALP Project FSEIS (Reclamation, 2000a). Violations of the water quality chronic standards are based on

[41] The State of Colorado has water quality jurisdiction on non-Indian land, but the Environmental Protection Agency and Southern Ute Indian Tribe do not agree with this arrangement. A recent agreement between the State of Colorado and the Tribe forms an Environment Commission which may resolve environmental conflicts between the two.

exceedences over a period of time (most standards state once in 3 years). Some States and Tribes allow an average of once every three years for a long period of record. Acute standards should never be exceeded.

***State and Tribal.*—**The States are required under the CWA to report to the EPA on the condition of the streams, rivers, and lakes within their boundaries. One of these reports is a list of impaired (does not meet its intended use) stream or river segments (referred to as a Section 303(d) list). This list generally indicates the waterbody segment, a probable source of pollutant(s), uses not supported, and specific pollutant(s). The agency must develop a plan to improve the condition of the waterbody and meet its intended use. The present status of listing is:

- ❑ The State of Colorado draft Section 2000 303(d) list does not have any San Juan River segments listed.

- ❑ The Tribes are encouraged but not required to report impaired waterbodies to the EPA.

- ❑ Based on the latest State of New Mexico Section 303(d) listing, the San Juan River designated uses are not supported on the following segments: (1) San Juan River from Canyon Largo to Navajo Dam (turbidity and stream bottom deposits), (2) from Animas River confluence to Canyon Largo (stream bottom sediments and fecal coliform), and (3) from the Navajo Nation boundary at the Hogback to Animas River confluence (stream bottom deposits).

- ❑ In the preceding State of Utah draft 2000 Section 303(d) listing, the San Juan River was removed from the year 2000 list because new waterbodies were delineated for the southeast Colorado watershed after an assessment was completed in 1998.

Impacts Analysis

No Action Alternative

No significant changes in Navajo Reservoir water quality are expected. Releases from Navajo Reservoir would be similar to those under historical 1973 - 91 period operations. Water quality parameters in the reservoir and in the San Juan River downstream to Lake Powell would probably be similar to existing conditions. Under the No Action Alternative, flow releases from Navajo Dam would not fall below 500 cfs under normal operations. Sources of pollutants along the river include municipal, industrial, and irrigation returns, and bank destabilization could occur mostly from Navajo Dam to Shiprock, New Mexico. Water quality in the San Juan River can also change rapidly from thunderstorm runoff in

streams and washes entering the river. Since the No Action Alternative flows would not be below NPDES permit critical low flows, NPDES permit facilities would not be affected along the San Juan River.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

As discussed in chapter II, flexibility is anticipated in irrigation season releases under the 250/5000 Alternative. This would reduce any impacts during the interim period; however, impacts discussed below are expected to occur over the long term.

No significant impacts to Navajo Reservoir water quality are anticipated under the 250/5000 Alternative. The spring releases from Navajo Reservoir would be maintained at 5,000 cfs, but releases the rest of the year could be lowered to 250 cfs. A 250-cfs release from Navajo Reservoir during the irrigation season would probably result in low flows (in the range of approximately 60-150 cfs) from Citizens Ditch (river mile 217) diversion to Farmington (river mile 181) due to irrigation demands. During the Summer Low Flow Test (Reclamation, 2002), several water quality parameters (temperature, aluminum, fecal coliform, total organic carbon, and conductivity) exceeded the State standards for this reach. Exceedences of water quality standards would probably increase at these lower flows over the long term.

Water quality parameter exceedences in the San Juan River from Farmington to Lake Powell would probably increase slightly, but significant increases in exceedences would probably not occur due to maintenance of the 500 cfs minimum flows in the critical habitat sections. Tables in Volume II show the number of exceedences occurring along the San Juan River at the major GS gaging stations when compared to representative State and Tribal standards[42].

A few exceedences occur under the 250/5000 Alternative at Archuleta, Farmington, Four Corners, and Bluff GS gages. The increase in exceedences at Shiprock occurs in fecal coliform, temperature, turbidity, and mercury. The exceedences in mercury probably occur because of the Navajo Nation coldwater habitat water use assigned to the San Juan River.[43] The coldwater habitat standards are lower than the other Navajo Nation water use standards and other regulatory agencies have the San Juan River designated as a warm water fishery.

[42] Data for these tables were taken from a STORET retrieval and consists mostly of GS and BIA data collected within the last few decades. The small number of sample results likely skew the exceedences, but give an indication of what could possibly happen under the flow regime of this alternative.

[43] Since the detection limit for mercury is higher than the standard, it is unknown if the standard is exceeded, and for this analysis it is assumed that the standard is exceeded because it is so low.

Facilities with NPDES permits could be affected by reduced low flows in the river. The facility most affected by the change in flows would be the Bloomfield wastewater treatment plant where the critical low flow of approximately 373 cfs is much higher than would occur under the 250/5000 Alternative. During the Summer Low Flow Test, flows in the vicinity of the Bloomfield wastewater treatment plant were 130 cfs, significantly lower than the critical low flow loading requirements for the permit. The facility may have to modify its treatment of wastewater to meet new discharge values when the permit comes up for renewal. Reclamation is working with the New Mexico State Department of Environment to further address this issue.

Other facilities along the river (Farmington and Shiprock wastewater treatment plants, and power plants) would not be impacted because they are in the area downstream of the confluence of the Animas River where flows are scheduled to be above 500 cfs. The critical low flows for most of these facilities range between 250 and 415 cfs.

500/5000 Alternative

No significant impacts to Navajo Reservoir water quality are anticipated under this alternative. Under the 500/5000 Alternative, releases from Navajo Reservoir would be maintained at present levels (500/5,000 cfs), with most of the flow at 500 cfs (76 percent of the time). Since releases from Navajo Reservoir would be around 500 cfs most of the year, water quality exceedences in the San Juan River mainstem would probably increase slightly or remain as is (Reclamation, 2000a). Facilities with NPDES permits would not be affected due to flows being above the critical low flow values in their permits most of the time.

Impacts Summary

The low releases after the spring runoff under the 250/5000 Alternative would probably result in concentration increases and possible exceedences of water quality standards. If the exceedences occurred more than once in 3 years, a violation of the State or Tribal standards would occur. Short-duration low flow tests indicated some parameters exceeded the State's standards from Navajo Dam to the Animas River confluence. Long-term summer low flows may cause exceedences of the water quality standards or an increase in bioaccumulation of some trace elements.

The New Mexico State Department of Environment is scheduled to complete Total Maximum Daily Load (TMDL) studies on several segments of the San Juan River within the next several years. The TMDLs will identify best management practices that might be implemented to reduce non-point source pollutant loads into the San Juan River. Best management practices taken to prevent violations of the State water quality standards would improve water quality in the river.

Facilities with NPDES permits would not be affected on the San Juan River except for the Bloomfield wastewater treatment plant, where the critical low flow (373 cfs) would be significantly higher than the flows in the San Juan River during 250 cfs releases from Navajo Reservoir. Revision of the Bloomfield wastewater treatment plant NPDES permit and associated load reductions from the plant, and implementation of best management practices to reduce loadings from non-point sources, could mitigate impacts on water quality of base flow releases of less than 500 cfs that would occur under the 250/5000 Alternative.

Under the action alternatives, regular springtime snowmelt-runoff period peak releases of up to 5,000 cfs would result in cleaning the San Juan River channel bottom of substantial amounts of suffocating sediment contributed by erosion of tributary drainages. Scouring of such sediment is periodically necessary to restore and maintain spawning gravel bars for endangered fish species and productive backwaters and side channels used by endangered fish for rearing habitats. Restoring such scouring is to restore natural, pre-dam function to the river.

LIMNOLOGY

This section addresses the potential impacts to limnology that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect limnological conditions in Navajo Reservoir?

Overview

Scope

The resources considered in the limnology analysis encompass Navajo Reservoir and its inflow areas—the Pine, Piedra, and San Juan Rivers arms.

Summary of Impacts

The water quality of Navajo Reservoir is expected to remain within historical limits, and no adverse impacts are identified for the No Action, 250/5000, and 500/5000 Alternatives.

Impact Indicators

Various biological, chemical, and physical variables were used in this evaluation; however the criteria used to determine any adverse limnological impacts from the alternative dam releases are as follows:

- ❑ Minor nutrient concentration changes in the reservoir with potentially reduced outflows
- ❑ Noticeable changes in biological productivity
- ❑ Changes to trophic state indices
- ❑ Substantial fluctuations in reservoir temperature profiles and stratification
- ❑ Changes in dissolved oxygen concentrations
- ❑ Noticeable changes in sediment deposition rates within the inflow areas

Affected Environment

Navajo Reservoir

Navajo Reservoir extends about 35 miles up the San Juan River, 13 miles up the Pine River, and 4 miles up the Piedra River into Colorado and has a storage capacity of 1,701,300 acre-feet at maximum water surface elevation 6085.0 feet (at the spillway crest). The dam has two outlet works (the main outlet work at elevation 5882.5 feet, and the auxiliary outlet works at elevation 5775.0 feet) as well as the auxiliary spillway (elevation 6085.0 feet). At its maximum elevation, the reservoir covers about 15,610 acres. The tributaries provide the majority of the water stored in the reservoir; however, several intermittent tributaries (arroyos) also contribute flows into the reservoir during storms. Variations in precipitation, dam operations, and contract water supply needs affect the seasonal fluctuations of the reservoir (Reclamation, 2001a).

Existing Reservoir Characteristics

Navajo Reservoir water elevations and storage capacities are shown in table III-10.

Nutrients.—Nutrients are important parameters within a lake or reservoir because phosphorous and nitrogen are the major nutrients required for the growth of algae and rooted vegetation in lakes (the primary producers within aquatic systems). Nutrient data for Navajo Reservoir are shown in table III-11.

Table III-10.—Navajo Reservoir water elevations and storage capacities

Date	Elevation (feet)	Live storage (acre-feet)	Releases (cfs)
January 19, 2000	6070.53	1,487,900	504.2
April 25, 2000	6072.20	1,511,300	04.2
August 29, 2000	6063.74	1,396,100	56.2
November 11, 2000	6057.63	1,318,000	04.2

Table III-11. — Nutrient summary data for 2000

	Location (mg/L)			
Variable	NAV 1[1]	NAV 2[1]	NAV 3[1]	NAV 4[1]
Ortho-P	0.010	0.009	0.012	0.011
Total P	0.017	0.019	0.031	0.021
NO3+NO2-N	0.087	0.075	0.041	0.031
Ammonia-N	0.015	0.023	0.022	0.028
Total Kjeldahl N	0.206	0.223	0.259	0.252
Total organic carbon	1.90	1.81	2.51	2.59
Diss. silica	5.12	5.05	6.34	5.48

[1] Shown in figure III-8.

Total phosphorous and nitrogen concentrations for each sampling location (see table III-11 and figure III-8) fall under the EPA's reference conditions for this ecoregion (see Volume II for definitions of EPA's reference conditions and ecoregions). Total organic carbon values observed at Navajo Reservoir range from 2.68 to 4.38 mg/L. Dissolved silica concentration values ranging from 5.90 to 11.25 mg/L in Navajo Reservoir suggest that observed silica concentrations fall below average[44].

[44] North American values derived Wetzel (2001).

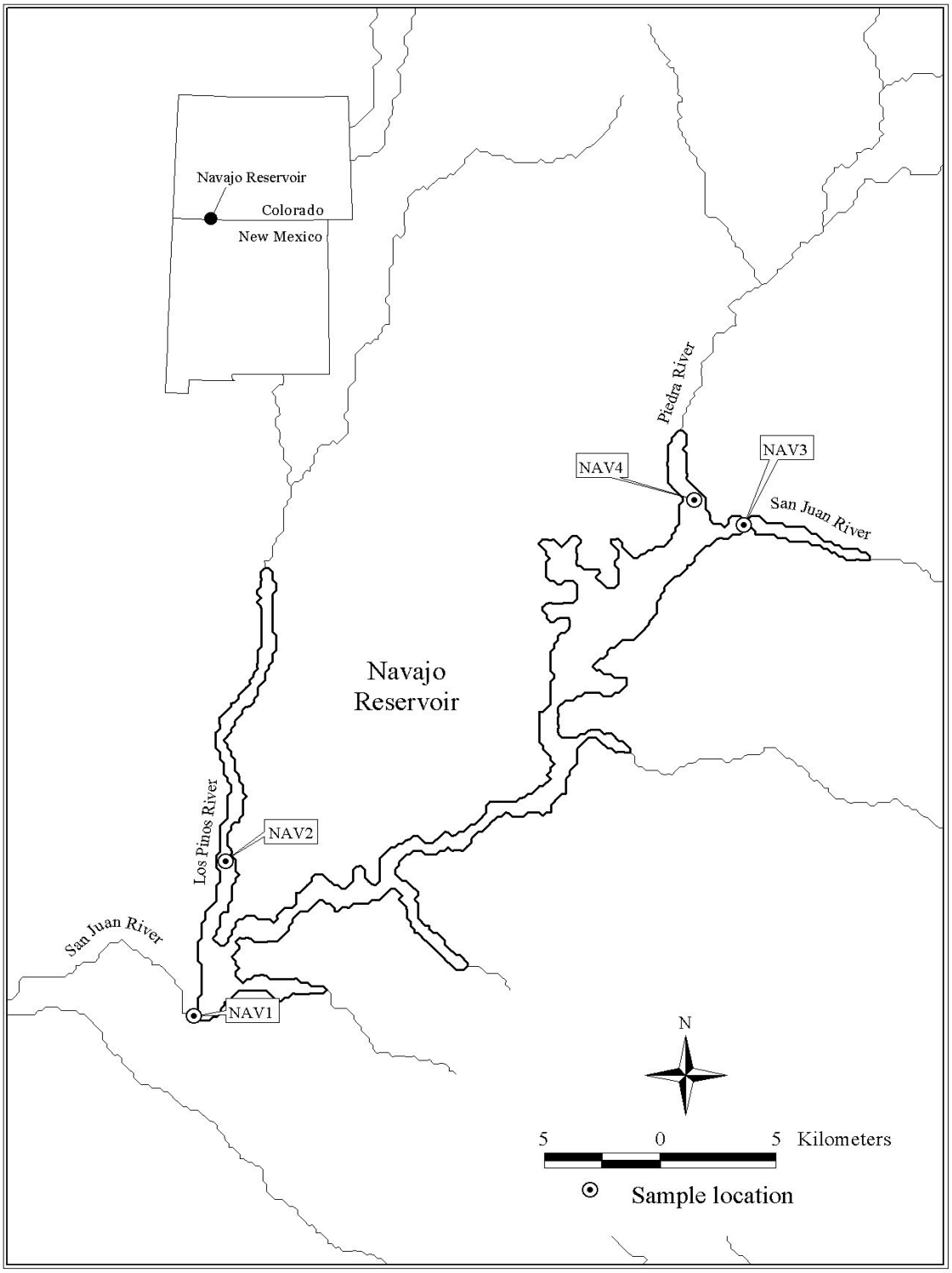


Figure III-8.—Map of Navajo Reservoir, including the limnological sampling locations.

***Biological Productivity.*—**Aquatic environments are made up of various biological communities that consist of groups of interacting populations of species. These communities are separated out into levels of functionality, or trophic levels, in which the various populations compete with each other for available resources.

Photosynthetic organisms, such as algae and aquatic plants, represent the first level of the trophic structure and are known as the primary producers. Measurement of chlorophyll *a* content is representative of the primary productivity of the upper portions of the water column in lakes and reservoirs. Table III-12 depicts the overall chlorophyll *a* content for all sampling locations during each sampling event.

Table III-12.—Chlorophyll *a* summary for Navajo Reservoir, in µg/L

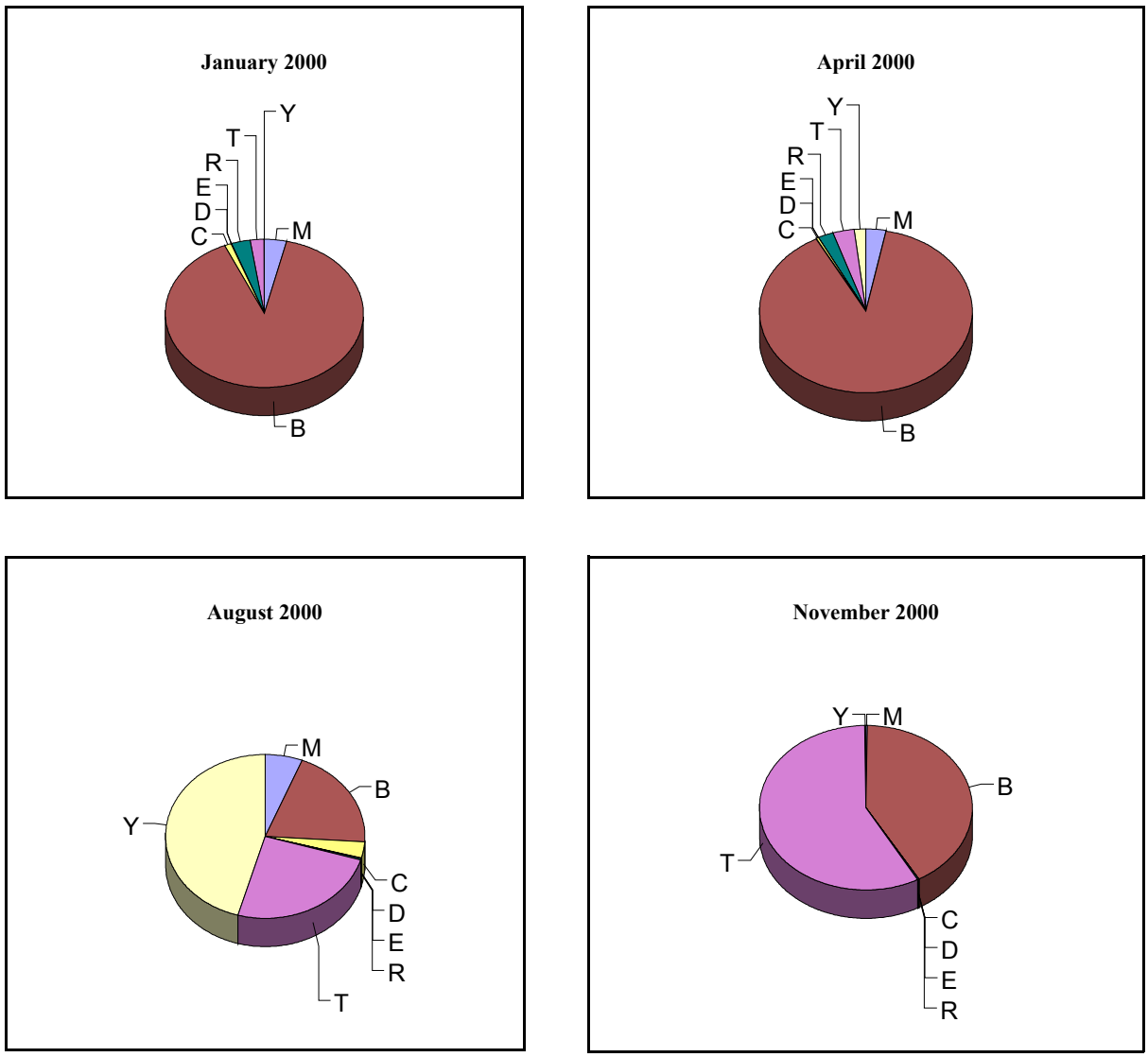
Sampling site	January 19, 2000	April 25, 2000	August 29, 2000	Average
NAV 1	0.79	3.03	1.32	1.71
NAV 2	0.69	1.08	1.97	1.24
NAV 3	2.24	2.27	5.30	3.27
NAV 4	7.17	3.88	2.74	4.59

The various types of populations that dominate aquatic environments can further be classified on the basis of their most common habitat. This study focused on the planktonic community. Plankton are the organisms that reside within the water column, and that are subject to water movement as a primary means of locomotion. Phytoplankton represent the various small plants (algae) or photosynthetic bacteria found within the water column. Figure III-9 depicts the various portions of phytoplankton observed during this study.

Zooplankton are macroscopic animals with very limited powers of locomotion that also exist within the water column. The three different classes of zooplankton found during this study can be seen in figure III-10.

***Trophic State Indices.*—**The Trophic State Index (TSI) of a lake or reservoir is a relative expression of the water body's biological productivity. This index is derived from observations in three different water quality variables: total phosphorous concentrations, chlorophyll *a* concentrations, and Secchi depths[45] (Carlson, 1977). These three values range from 1 to 100. A TSI value of less than 35 indicates oligotrophic conditions. Mesotrophic conditions are noted at TSI values between 35 and 50. Eutrophic conditions are seen at TSI

[45] Secchi depth is a measure of the absorption characteristics of water and its dissolved and particulate matter.



Chlorophyta (**C**), Pyrrhophyta (**D**), Cryptophyta (**R**), Cyanophyta (**B**), Bacillariophyceae (**T**), Chrysophyta (**Y**), Euglenophyta (**E**), and a miscellaneous category (**M**) which consisted of various other algal types.

Figure III-9.—Average phytoplankton structure for Navajo Reservoir, in cells/mL.

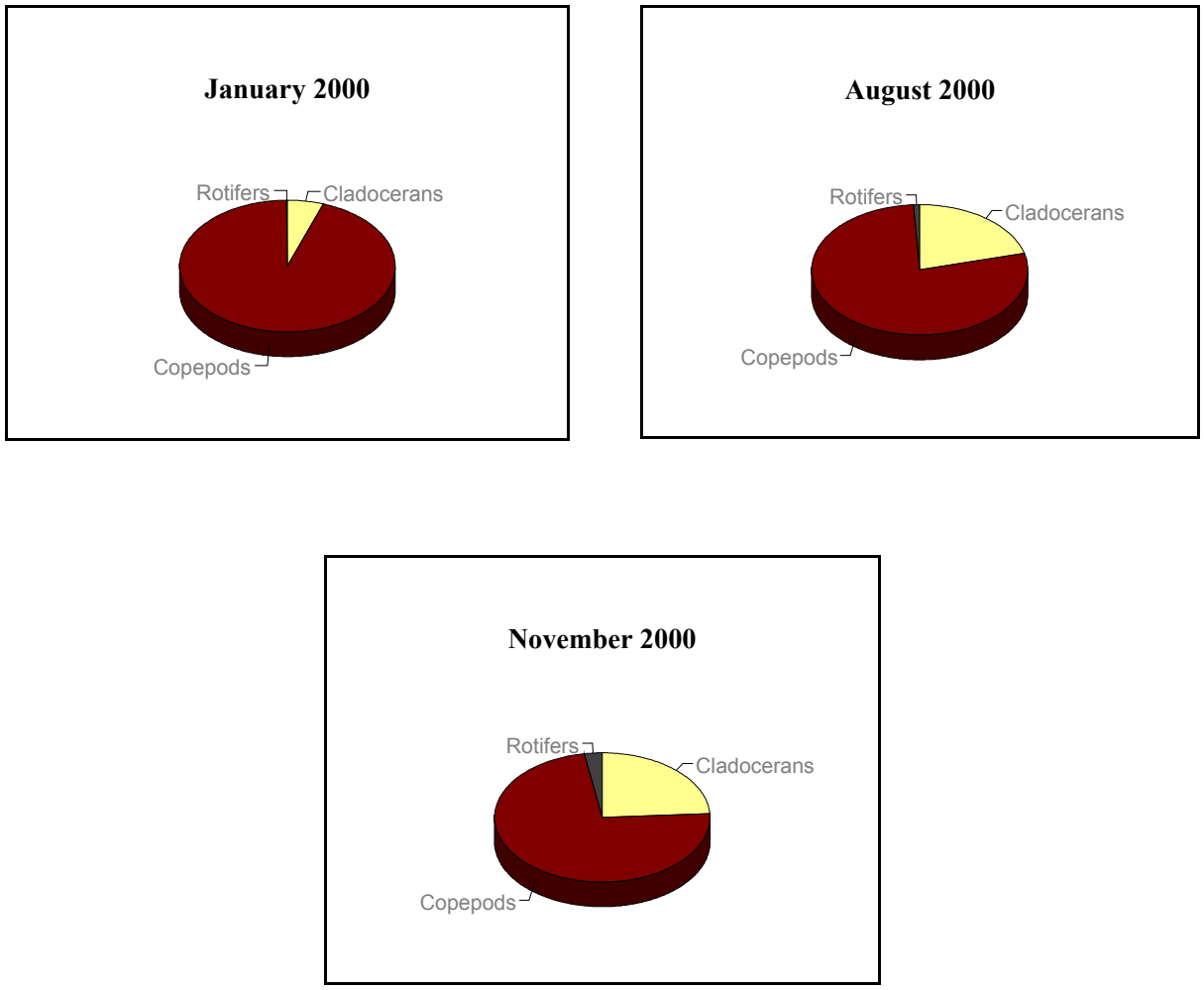


Figure III-10.—Average zooplankton structure for Navajo Reservoir.

values greater than 50, whereas hypereutrophic conditions are seen at values greater than 70. Higher numbers are usually associated with nuisance conditions such as undesirable algal blooms.

Navajo Reservoir TSI values were calculated and reported in table III-13. These values were also compared to similar reservoirs to gain some understanding as to the present conditions of Navajo Reservoir. The values reported were for the month of August, which is usually the period of maximum biological productivity.

Table III-13.—Comparison of Navajo Reservoir's trophic state indices to similar reservoirs

Reservoir	Total P	Chlorophyll *a*	Secchi depth
NAV 1	36.6	33.3	36.2
NAV 2	43.4	37.2	38.0
NAV 3	57.7	46.9	73.2
NAV 4	40.0	40.5	60.0
EB I[1]†	73.2	41.4	44.7
BMR-S[2]‡	-	39.6	43.7
BMR-C[3]‡	-	38.5	39.3
BMR-I[4]‡	-	40.5	45.9

- No data were available.
[1] Elephant Butte Reservoir collection site located at the buoy line at the dam.
[2] Blue Mesa Reservoir, Colorado - Sapinero Basin.
[3] Blue Mesa Reservoir, Colorado - Cebolla Basin.
[4] Blue Mesa Reservoir, Colorado - Iola Basin
† From Canavan, 2001. Data used were from August 1999.
‡ From Johnson et. al, 1996. Data used were from August 1995.

Temperature and Dissolved Oxygen (DO).—Navajo Reservoir's temperatures exhibit normal seasonal patterns, ranging from a maximum surface temperature of 23.4° C at NAV 2 on August 29, 2000 and a minimum surface temperature of 3.7° C at NAV 4 on January 19, 2000.

Oxygen levels were relatively uniform during January and April with slightly lower oxygen levels near the bottom of the water column. Slight increases in DO concentrations at two

sampling sites (NAV1 and NAV2) in April 2000 could possibly signal the beginning of spring turnover. The DO levels observed at NAV2 resemble the beginning of spring turnover since the concentrations are varied with respect to increasing depth.

Temperature and DO concentrations for August 2000 at the same sites exhibit a strong thermocline beginning around 15 meters in depth and extending to about 40 meters in depth. DO concentrations at both sites exhibit a decrease in concentration right at the top of the thermocline, which is common, since this area tends to be quite productive with respect to biological activity. Otherwise, concentrations increase with respect to depth as a result of decreasing temperatures.

Other Parameters. —Major ions and solids for Navajo Reservoir are summarized in table III-14. These data are presented as averages calculated from concentrations of samples collected at all depths and stations.

Table III-14. —Major ions and solids summary data for 2000

	Location (mg/L)				
Variable	NAV 1	NAV 2	NAV 3	NAV 4	N. America[1]
Ca^{++}	23.8	23.9	22.9	26.0	21.0
Mg^{++}	4.39	4.38	4.84	5.03	5.00
Na^{+}	10.19	9.86	10.55	8.84	9.00
K^{+}	1.78	1.47	1.43	1.64	1.40
HCO_3^{-}	89.5	89.5	83.5	88.5	68.0
$SO_4^{=}$	29.5	28.8	34.2	35.1	20.0
Cl^{-}	1.92	1.85	1.96	1.90	8.00
Sr	0.225	0.225	0.214	0.240	-
B	0.014	0.012	0.018	0.014	-
TDS	143.5	159.4	161.7	169.1	-
TSS	3.4	8.4	11.4	10.0	-

[1] North American values derived from Wetzel (2001).

Most of the variables seen in table III-14 are relatively close to the values noted for North America (Wetzel, 2001) with higher concentrations in $HCO3^-$ and $SO4^=$ and lower Cl^- concentrations noted for Navajo Reservoir. Most of the variables exhibited little change between sampling locations. Near the dam (NAV 1), there is a considerable drop in the concentrations of dissolved and suspended solids. This natural occurrence is due to the settling process as rivers drain into reservoirs and as the water flow changes.

To assess sedimentation, Secchi depth measurements were performed, as shown in table III-15, as a way of visually gauging the clarity of the upper water column. This measurement, as well as total dissolved solids (TDS) and total suspended solids (TSS) , can give an indication of the amounts of suspended matter within the water column.

Table III-15.—Navajo Reservoir Secchi depth measurements (meters) and the solids fractions (mg/L)

Date	NAV 1	NAV 2	NAV 3	NAV 4
January 19, 2000	1.07	0.86	1.02	0.95
April 25, 2000	3.20	2.20	0.30	0.50
August 29, 2000	5.20	4.60	0.40	1.00
November 11, 2000	5.60	1.80	0.70	0.70
TDS	143.5	159.4	161.7	169.1
TSS	3.4	8.4	11.4	10.0

Lastly, total trace metal concentrations were quantified during April 2000. Total trace metals consist of readily available (dissolved) and particulate metals that are bound to suspended materials within the water column. Most of the trace metals observed were within EPA drinking water standards (EPA, 1976)[46]. Aluminum, iron, and lead were the only trace metals that surpassed known standards during this sampling regime.

San Juan River Arm of the Reservoir

Streamflow in the San Juan River is mostly attributed to melting snowpack. The river peaks in the springtime and tapers off in the summer and fall, with periodic increases in flow caused by storms. The San Juan River provides the majority of inflow into Navajo

[46] While drinking water standards are not applied at a reservoir management level, they were used as an example in this section because the standards are usually more stringent than chronic standards used for fisheries management.

Reservoir, as well as acting as the greatest sediment-load contributor into the system. The river, regulated by Navajo Reservoir, and its tributaries sustain substantial irrigation use (Reclamation, 2000a).

Pine River Arm of the Reservoir

Streamflow in the Pine River is mostly attributed to melting snowpack. Streamflow is highly variable throughout the year with higher flows (up to 2,700 cfs) during the springtime melt of the snowpack. A reduction in flow occurs from midsummer through fall (down to 100 - 200 cfs). Below irrigation diversions on the Pine River, however, certain stretches of the stream are usually dewatered. The mean monthly inflows into Navajo Reservoir can vary from 6 to 2,000 cfs. Historically, water quality of the Pine River is high despite some irrigation and M&I return flows in the lower portion of the system (Reclamation, 2000a).

Piedra River Arm of the Reservoir

The Piedra River's streamflow is attributed mostly to melting snowpack. Streamflow varies annually, with peak flows up to 1,500 cfs during the spring runoff. Flows are reduced to 70 - 100 cfs midsummer through fall. The mean annual flow for the Piedra River is about 416 cfs. The water quality of the Piedra River is considered relatively good (Reclamation, 2000a).

Methodology

This study measured potential impacts in terms of (1) nutrient concentration changes within the reservoir, (2) noticeable changes in biological productivity, (3) changes in trophic state indices, (4) substantial changes in reservoir temperature profiles and stratification, (5) DO concentrations, and (6) suspended sediment fractions.

The study also measured general physical conditions and water quality parameters of Navajo Reservoir, which include nutrients, physical and chemical profiles, biological productivity, light penetration, TSS and TDS, total organic carbon, major ions and trace metals.[47] These variables were selected to provide information on key physical and chemical

[47] Trace metals included aluminum, arsenic, barium, boron, cadmium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, selenium, silver, strontium, vanadium, and zinc.

characteristics of Navajo Reservoir, including mixing processes, nutrient dynamics, trophic state variables, and general water quality. The complete technical discussion of methodology is included in Volume II of this DEIS.

Releases of water within Navajo Reservoir that correspond to limnological sampling dates are shown in table III-16. Samples were collected on a quarterly basis (January, April, August, and November of 2000).[48] These surface and bottom samples were collected in January, April, and November 2000, and, in addition, samples were taken from the surface, bottom of the epilimnion (upper, warmer water), top of the hypolimnion (lower, colder water), and near the bottom during August.

Table III-16.—Summary of effects on limnological indicators from proposed alternatives compared to the No Action Alternative

Indicator	No Action	250/5000	500/5000
Nutrients (mg/L)	(Preceding nutrient summary data for 2000 table)	SNA[1]	SNA
Biological Indicators	(Preceding table showing chlorophyll summary for Navajo Reservoir and two figures showing phytoplankton and zooplankton structures for the reservoir)	SNA	SNA
Trophic State Index	(Preceding table comparing Navajo Reservoir trophic state indices to similar reservoirs)	SNA	SNA
Temperature (˚C)	3.7 - 23.4	SNA	SNA
Dissolved Oxygen (mg/L)	2.28 - 10.06	SNA	SNA
Secchi depth (meters) (light penetration)	0.30 - 5.60	SNA	SNA

[1] Similar to No Action.

Lastly, physical and chemical profiles were collected at each sampling location at intervals from the surface to near the bottom for general chemistry and physical variables (temperature, DO concentration, pH (measure of alkalinity/acidity), conductance, turbidity, oxidation-reduction potential, and Secchi depth).

[48] Samples were collected as surface grabs from the lake surface and by using a Kemmerer sampler at other depths.

Impacts Analysis

The water quality of Navajo Reservoir is expected to remain within historical limits, and no adverse impacts have been identified for the No Action and action alternatives.

No Action Alternative

The water quality of Navajo Reservoir is expected to remain within historical limits and no adverse impacts have been identified with respect to nutrients, biological productivity, trophic state, temperature, DO concentrations, and/or sedimentation. Releases seen during this study ranged from 504.2 to 765.2 cfs during the limnological sampling events, which remains within historical operation.

250/5000 Alternative (Preferred Alternative) (Flow Recommendation)

Reduced flows (250/5000 Alternative) from Navajo Dam's main outlet works could suggest that at certain times of the year more water may reside in live storage. If so, temperature profiles (thermoclines) may be more pronounced in the deeper portions of the reservoir. Otherwise, impacts to the other limnological variables would be similar to those of the No Action Alternative.

500/5000 Alternative

Impacts would be similar to those of the No Action Alternative in that historical reservoir operations (from 1973 to 1991) have been quite similar to this alternative.

SOCIOECONOMICS

This section addresses the potential impacts to social and economic sectors that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect local economies?

Overview

Scope

The primary area of direct impact includes all or parts of San Juan Counties in New Mexico and Utah, and Archuleta County, Colorado; Navajo Nation Lands; and the Jicarilla Apache, Ute Mountain Ute, and Southern Ute Indian Reservations. Impacts to American Indian Tribes and Tribal nations are included in the ITA/EJ section of this DEIS. Other counties outside the above scope may be negligibly affected, and as a result have not been included in this analysis.

Summary of Impacts

The impacts of limited future development of NIIP, the inability to construct the ALP Project, and impacts from the Jicarilla Apache Nation third-party contract with PNM for the San Juan Generating Station could occur under the No Action and 500/5000 Alternatives. Local economies associated with water use, such as recreation and tourism below Navajo Dam could be adversely affected under the 250/5000 Alternative. Over the long term, the 250/5000 Alternative would benefit water development and agriculture and support industries in the project area and local communities.

Impact Indicators

Impacts were identified as a result of any changes in:

- ❑ Direct, indirect, and induced gross sales revenues of a county
- ❑ The number of jobs within a county
- ❑ Total county tourism/recreation receipts
- ❑ Total county agricultural crop sales
- ❑ The income and number of employees of local businesses dependent on river flows

Affected Environment

The sections below discuss the existing socioeconomic conditions in the areas potentially affected by changes in releases from Navajo Dam. The descriptions provided use the most

current data available at the time that this DEIS was written. Census information collected in the year 2000 had not been completely tabulated and analyzed; however, current population numbers that were available have been used. In addition, each State and county provided information and data in differing formats and levels of detail which occasionally prevented specific comparisons between affected areas.

The most significantly impacted area comprises three counties in three States, each of which borders stretches of the San Juan River: San Juan County in northwestern New Mexico, San Juan County in southeastern Utah, and Archuleta County in Colorado, which contains part of Navajo Reservoir. The Navajo, Ute Mountain Ute, Southern Ute Indian, and Jicarilla Apache Reservations, parts of which are located in counties adjacent to the primary affected area, would also be impacted by the proposed action, as discussed in greater detail in the ITA/EJ section in this chapter.

Economically, the impacted areas rely on the diverse industries of mineral extraction and recreation/tourism, and, to a smaller extent, on agriculture. San Juan County, New Mexico, was developed as a result of livestock ranching, but the development of the county's oil and gas deposits from 1970 through the 1990s brought economic gain. San Juan County, Utah, was also developed as a result of livestock ranching, but uranium mining predominated in the 1950s and the creation of Lake Powell in the 1960s made tourism one of the county's most significant economic resources (Utah Economic Development Department, 1999). Archuleta County developed as a result of such traditional western commodities as minerals, cattle, and timber, but since the 1970s the county has been in transition to a more tourist-related environment (Colorado State Information Services, 1999).

San Juan County, New Mexico

Tourism/Recreation.—Tourism in San Juan County, New Mexico is most active during the summer months. Fishing, water-skiing, sailing, boating, and parasailing are available on the San Juan River and Navajo Reservoir, as well as on a number of lakes in the area.

Tourists can also mountain bike, hike, backpack, horseback ride, and hunt for big game, upland birds, and waterfowl. Quality trout fishing on the San Juan River below Navajo Dam attracts anglers from all over the United States and many foreign countries. Historic sites include Aztec Ruins National Monument, Salmon Ruins, Aztec Museum, and Pioneer Village. Travel and tourism expenditures in San Juan County amounted to more than $100 million in 1998.

San Juan County, New Mexico

Major industries: Government, services, mining, and trade (major retail hub)

Major employers: Navajo Nation, San Juan Generating Station, and Four Corners Power Plant

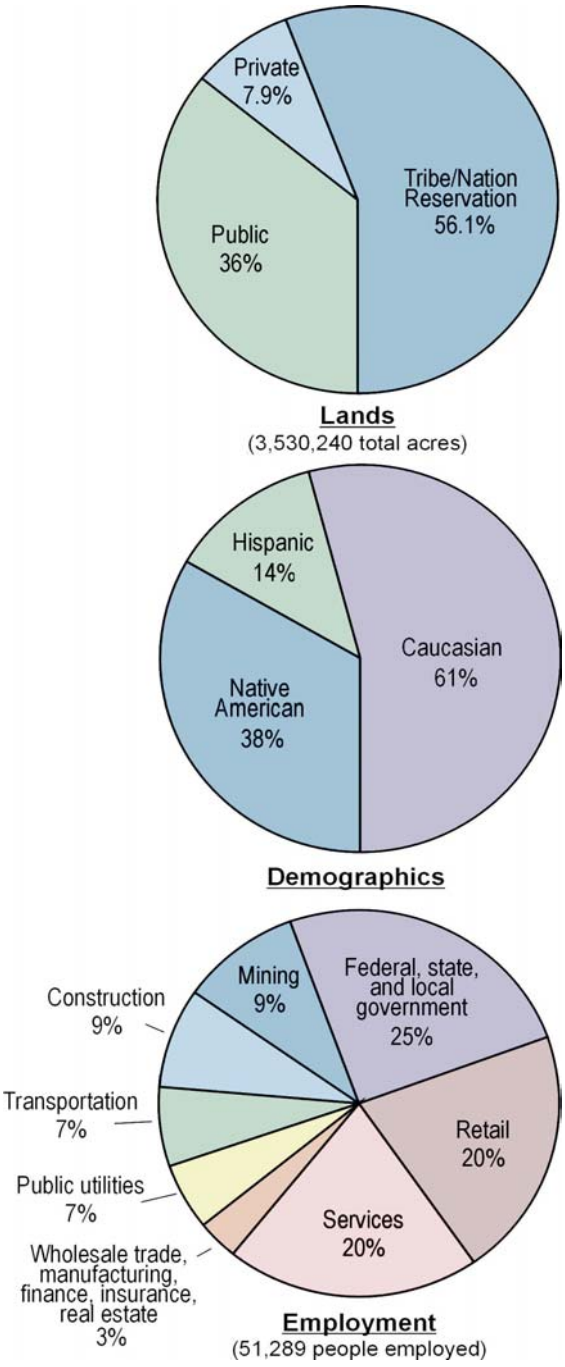
Largest municipality: Farmington, population 37,844

County population: 113,801

Average growth rate: About 3 percent 1990-2000 (National average 1.01 percent)

Per capita income: $16,749 (14th of 33 counties in 1997; about two-thirds of State and National average)

Unemployment rate: 9.7 percent (1997); (New Mexico was 6.2 percent [1997])



Figures III-11 through III-13.—Lands, demographics, and employment (San Juan County, New Mexico).

***Agriculture.*—**The 1997 agricultural census of San Juan County estimated there were approximately 666 farms in the county totaling about 1,857,223 acres of land, including crop production and range operations. About 85 percent of these farms were composed of fewer than 179 acres. Total cropland amounted to 84,000 acres, of which 68,500 acres were irrigated and about 61,000 were harvested. The agricultural sector employed about 1,300 in 1997, which represents about 3 percent of the total workforce, and payroll earnings for this sector were $28,388,000, or a little more than 2 percent of the county's total earnings (USDA, 1997).

San Juan County ranks eighth in agricultural production among New Mexico counties, with cash receipts from all farm commodities of $70,409,000 (USDA, 1997). Agriculture makes up about 4 percent of county gross receipts and less than 1 percent of total retail sales. Services, mining, and wholesale and retail trade are the predominant industries.

***Retail Sales.*—**San Juan County serves as the major retail hub for the neighboring counties in both New Mexico and Colorado. While largely dependent on the oil and gas sectors, San Juan County is developing a strong service base.

Table III-17 shows the gross receipts of retail sales in 1997.

San Juan County, Utah

***Tourism/Recreation.*—**Summer tourism in San Juan County is heavy, and centers on the area's natural environment. Recreational activities include river rafting, kayaking, fishing, hiking, rock climbing, and mountain biking. Thousands of tourists per year travel to nearby national parks, monuments, and recreation areas, including Natural Bridges, Arches, Monument Valley, Glen Canyon, and Canyonlands. The creation of Lake Powell in the 1960's has continued to make tourism one of the county's most important economic resources.

Travel and tourism expenditures in 1997 totaled almost $44 million. The tourist industry includes Monument Valley Lodge, Halls Crossing Resort and Marina, local commercial river rafting and tour companies, and several smaller enterprises.

***Agriculture.*—**There were 1,673,079 acres of farmland countywide in l997, according to the Census of Agriculture for that year. Of the 231 farms in 1997, 115 were considered full-time operations, most of them involving livestock production.

San Juan County, Utah

Major industries: Tourism and education

Major employers: San Juan School District, tourism, Navajo Nation

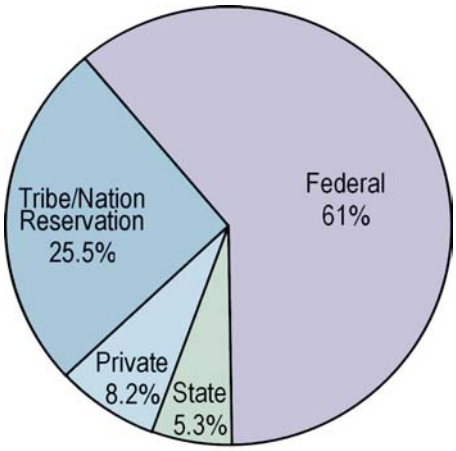
Largest municipality: Blanding, population 3,516 (1998)

County population: 13,561 (1.7 people per square mile)

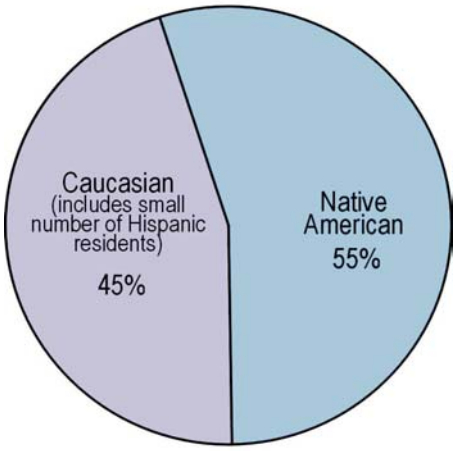
Average growth rate: 0.8 percent (1990s) (National average 1.01 percent)

Per capita income: $11,080 (lowest among Utah counties; 55 percent of State average and 46 percent of National average)

Unemployment rate: 8.2 percent (1997) (second highest in State, where average was 3.8 percent that year)



Lands
(5,005,561 total acres)



Demographics

Figures III-14 and III-15.—Lands and demographics (San Juan County, Utah).

Principal crops grown are wheat, barley, oats, and alfalfa. Cash receipts from all farm commodities amounted to more than $9 million. In 1997, the agricultural sector employed 0.5 percent of the total workforce and payroll earnings for this sector were $151,000, representing less than 1 percent of the county's total earnings (USDA, 1997).

Retail Sales.—San Juan County retail sales totaled more than $102 million in 1998. Table III-18 compares the sales amounts and proportions of the major various retail sales sectors in 1998.

Table III-17.—Comparison of retail sales sectors in San Juan County, New Mexico (1997)

Industry	Sales ($)	Percent of total
Agriculture	2,217,000	0.1
Mining	525,663,000	23.9
Construction	249,819,000	11.3
Manufacturing	94,341,000	4.3
Transportation, communication, and utilities	101,593,000	4.6
Wholesale trade	446,578,000	20.3
Retail trade	783,113,000	35.5
Total retail sales	2,203,324,000	100.0

Source: New Mexico Department of Economic Development.

Table III-18.—Comparison of retail sales sectors in San Juan County, Utah

Industry	Sales ($)	Percent of total
Mining	12,779,000	12.5
Construction	3,541,000	3.4
Manufacturing	2,817,000	2.8
Transportation and public utilities	10,458,000	10.2
Wholesale trade retail sales	10,561,000	10.3
Building materials and farm equipment	2,753,000	2.7
General	385,000	0.4
Food stores	10,807,000	10.6
Auto and service stations	4,896,000	4.8
Apparel and accessories stores	263,000	0.3
Home furnishing stores	827,000	0.8
Eating and drinking places	3,252,000	3.1
Miscellaneous stores	5,174,000	5.1
Finance, insurance, and real estate	819,000	0.8
Hotels and other lodging places	10,479,000	10.2
Services other than lodging	13,913,000	13.6
Other industries	8,635,000	8.4
Total retail sales	102,359,000	100.0

Source: Utah State Tax Commission.
Note: Agriculture is not included because it is not a major retail sector in county economy.

Archuleta County, Colorado

***Tourism/Recreation.*—**Tourism has replaced timber and wood products industries as the major economic industry. Archuleta County's tourism centers on the area's natural environment, with the hot springs located in Pagosa Springs as an example. Winter sports are a major attraction at Wolf Creek Ski Area near Pagosa Springs. Other recreational activities include golf, fishing, hunting, and hiking, along with camping and water-related activities at Navajo Reservoir. Tourism and travel spending in the county amounted to more than $26 million in 1997.

***Agriculture.*—**There were 112,670 acres of farmland countywide in Archuleta County. Of the 206 farms in 1997, 125 were involved in livestock production. Principal crops grown are pasture, grass hay, alfalfa, and a small amount of wheat. In 1996, the agricultural sector employed 5 percent of the total workforce and payroll earnings for this sector were $768,000, representing about 1 percent of the county's total earnings (USDA, 1997).

Archuleta County ranks 48th in agricultural production among 63 Colorado counties, with a cash receipt from all farm commodities of $6,921,000 (USDA, 1997). Agriculture makes up less than 5 percent of county gross receipts and about one-half of 1 percent of total retail sales.

***Retail Sales.*—**Archuleta County experienced retail sales totaling more than $118 million in 1997. Table III-19 compares the sales amounts and proportions of the various retail sales sectors in 1997. Food stores (19 percent) and retail building materials and farm equipment (18 percent) had the strongest sales, followed by other miscellaneous retail industries (12 percent), and services other than lodging and retail eating and drinking places (each at 8 percent).

Methodology

The socioeconomic analysis presented in this section discusses potential direct, indirect, and induced impacts that could occur in the three counties previously identified.[49]

[49] Direct effects are production changes created by the initial or first-round expenditures for goods and services. Indirect effects result from secondary spending related to initial industries' sales. Induced effects are changes in economic activity resulting from household spending of income earned directly or indirectly from the initial expenditure.

Archuleta County, Colorado

Major industries: Tourism and recreation

Major employers: Service, retail, and construction

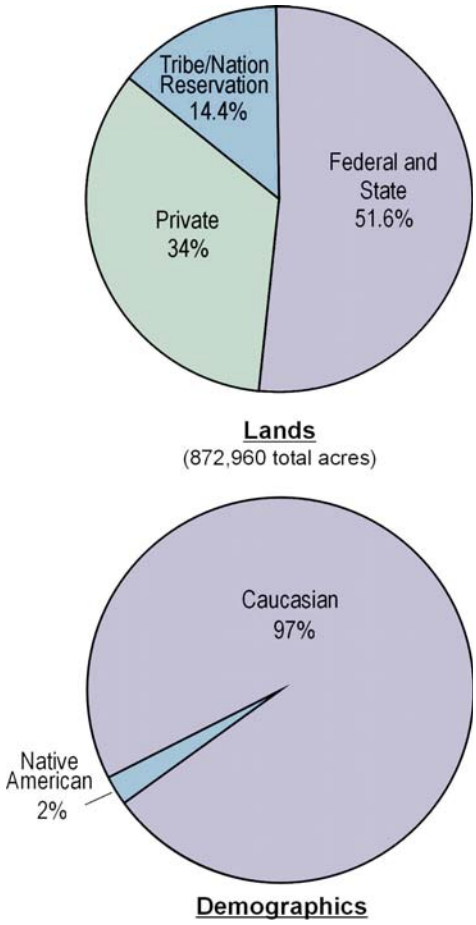
Largest municipality: Pagosa Springs, population about 1,800

County population: 9,142

Average growth rate: 8.3 percent (1990s) (National average 1.1 percent)

Per capita income: 14,741 (58th out of 63 State counties; 51 percent of State average; and 61 percent of National average)

Unemployment rate: 5.2 percent (1997) (State was 3.3 percent)



Figures III-16 and III-17.—Lands and demographics (Archuleta County, Colorado).

The movement of goods and services within a regional economy and expenditures outside the region can be estimated using models which reflect production requirements for goods and services within the proposed area of impact. This analysis utilized a computer-based modeling program[50] to calculate direct, indirect, and induced effects of the economic activity. All values are presented in 1999 dollars and revenues are considered to have been received in 1999. The model used is described in technical attachments included in Volume II.

[50] IMPLAN Professional (Version 2.0).

Table III-19.—Comparison of retail sales sectors in Archuleta County, Colorado, in 1997

Industry	Sales ($)	Percent of total
Agriculture	621,000	1.0
Construction	5,288,000	4.0
Manufacturing	2,391,000	2.0
Transportation and public utilities	7,258,000	6.0
Wholesale trade retail sales	5,344,000	5.0
Building materials and farm equipment	20,845,000	18.0
Food stores	22,820,000	19.0
Auto and service stations	8,671,000	7.0
Apparel and accessories stores	1,218,000	1.0
Home furnishing stores	3,337,000	3.0
Eating and drinking places	9,562,000	8.0
Finance, insurance, and real estate	823,000	1.0
Hotels and other lodging places	6,431,000	5.0
Services other than lodging	9,298,000	8.0
Other industries	14,174,000	12.0
Total retail sales	118,081,000	100.0

Source: Region 9 Economic Development District, 1999.

Estimated impacts for all industries on a per-county basis were measured using total output, total value added, employee compensation and jobs. Total value added is a fairly reliable measurement of total income or benefit associated with employment in all industries in the county economy. Also analyzed are impacts to employee compensation and total jobs. Table III-20 provides the baseline data from which impacts were measured for the three counties.

Information on fishing, rafting, and related expenditures was collected from State and local governments, visitor bureaus, fishing and river rafting guides, and restaurant, lodging, and retail store owners from Navajo Reservoir to Mexican Hat, Utah on the San Juan River.

In any county regional impact analysis, only out-of-county and out-of-State visitor expenditures are considered as a net gain in revenues, incomes, and employment. In-county resident fishing expenditures are not considered an impact because it is assumed that they

Table III-20.—Baseline data for Archuleta County, Colorado, San Juan County, New Mexico, and San Juan County, Utah

County	Output for all industries (1999 dollars)	Total value added for all industries (1999 dollars)	Total employee compensation for all industry sectors (1997)	Total jobs (1997 data)
Archuleta County, Colorado	277,984,000	161,393,000	68,565,000	4,299
San Juan County, Utah	276,819,000	161,465,000	103,841,000	5,346
San Juan County, New Mexico	3,992,651,000	2,364,783,000	1,205,444,000	49,933

would make the same local expenditures on some form of recreation if fishing on the river did not exist. Out-of-State anglers would presumably make their fishing expenditures in their home locality if the San Juan River were closed or did not exist.

Impacts Analysis

In general, only those resource areas that would be impacted socioeconomically by the alternatives are discussed. The primary impact area comprises the two San Juan counties through which the San Juan River flows in New Mexico and Utah before entering Lake Powell.

Overall, the county economy may be so diversified that changes in specific sectors such as recreation and tourism have very insignificant impacts on the overall county output; however, local areas that have limited economic bases (like the small communities and towns along the San Juan River) can be particularly impacted.

Providing and maintaining recreational/tourism opportunities that bring people into these areas does make a significant difference to local incomes and employment. Improving economic activity in these rural areas has been and continues to be a longstanding public policy objective.

For the 250/5000 Alternative (Preferred Alternative) (Flow Recommendations), water supplies to users would remain intact, maintaining those resources without adverse impact. Based on observations during the Summer Low Flow Test, the areas of major socioeconomic impact under the Preferred Alternative would include river recreation uses and hydropower generation at the City of Farmington power plant. Under the No Action and 500/5000 Alternatives, some existing and future major economic development would be jeopardized to an undetermined extent, and additional income and employment impacts would be

expected. The economic analysis for this DEIS does not include future non-binding or unspecified water development projects for Indian and non-Indian uses because their economic impacts have not been finalized.

No Action Alternative

The area would continue to follow the economic course which is currently being pursued. The following could be jeopardized: Future development of agricultural land on the Navajo reservation; M&I water supplies; and water settlements of the Ute Mountain Ute and Southern Ute Indian Tribes and the Jicarilla Apache Nation.

Navajo Indian Irrigation Project (NIIP).—In San Juan County, New Mexico, NIIP has currently developed 65,000 acres (Blocks 1-8), but under the No Action Alternative, Blocks 9 -11—consisting of an additional 45,630 acres—may not be developed. In addition, water supply that was transferred to the NIIP from the Fruitland and Hogback Projects for completion of NIIP Blocks 7 & 8 under an earlier consultation may no longer be available. This would effectively revert the NIIP to the irrigated area of Blocks 1-6 for a total acreage of 54,500, leaving the project 56,130 acres short of full development. This could result in an estimated future loss of $40.3 million in annual gross crop revenues for that county (table III-21).

Table III-21.—Projected lost annual crop revenues (gross) without future completion of NIIP

Crop	Acreage	Revenue/acre ($)	Lost crop revenue[1] ($)
Alfalfa	8,420	618	5,203,251
Winter wheat	19,084	322	6,145,112
Corn	12,349	422	5,211,109
Dry beans	9,542	467	4,456,161
Potatoes	6,736	2,857	19,243,609
Total	56,130		40,259,243

[1] Rounded.

As a result, total output not realized annually for the county could be $55,086,000 which is about 1.3 percent of the total county output. Lost additional income that would have been generated in the county annually is estimated to be $14,488,000, which is about 1.2 percent of total employee compensation in the county, with the lost opportunity of adding 921 jobs.

This reduced employment opportunity would be particularly detrimental to the Navajo Nation and the region, which is categorized by the Federal Government as an area of high unemployment.

Animas-La Plata Project (ALP Project).—Under the No Action Alternative the planned development of the ALP Project may not be able to proceed. This could result in possible loss of projected water development capital expenditures of approximately $227 million, not including construction costs for non-binding end uses. Unspecified losses to non-Indian M&I water development would also occur. Specific details and estimates for non-completion of the ALP Project and the associated impacts to La Plata County, Colorado, can be referenced in the ALP Project FSEIS (Reclamation, 2000a).

Jicarilla Apache Nation Third-party Contract with PNM.— Under the No Action Alternative the Jicarilla Apache Nation third-party contract with PNM supplying water to the San Juan Generating Station (SJGS) could be at risk because of the need for ESA reconsultation. It is doubtful that the water supply to SJGS would be interrupted; however, if it was, the following resulting impacts could be realized:

- ❑ The direct impact of employment loss of approximately 440 jobs at SJGS with another 400 jobs at the Broken Hill Proprietary, Ltd. (BHP) coal mines that supply coal to the generating station.
- ❑ Loss of power generated for more than 30 western utilities, municipalities and cooperatives; replacement sources of electricity to meet their needs, at possibly higher costs (Reclamation 2001c).
- ❑ Adverse impacts to the local economy would also be expected with the accompanying loss of personal incomes and expenditures.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

Socioeconomic impacts under the Preferred Alternative are measured in the following areas:

- ❑ Recreation/Tourism
- ❑ San Juan River Fishing in Navajo State Park–Out-of-State anglers
- ❑ San Juan River Rafting—Commercial rafting outfitters and private boating
- ❑ Agriculture

***Recreation/Tourism.*—**The following analysis describes some of the local economic impacts of expenditures by recreationists on local business activity, household income, and employment, primarily in San Juan Counties, New Mexico and Utah. Impacts to recreation at Navajo Reservoir from operational changes at the dam were determined to be negligible.

San Juan River Fishing – Navajo State Park.— Most fishing on the San Juan River takes place between Navajo Dam and the Hammond Diversion, predominantly in the 4.4 miles designated by NMDGF as Quality Waters, where large numbers of anglers come to fish from all over the world. Only the regional impacts of fishing in the quality waters and part of the regular waters downstream were analyzed for this document.

Out-of-State Anglers.—Two separate estimates of out-of-State angler expenditures were provided. Angler expenditures were estimated at $400 per trip per person based on a study done in 1994[51]. Expenditures estimated at $462 per trip were provided by fly fishing outfitters and guides. Per trip estimates were based on one day of fishing and expenditures as identified in figure III-18.

An average annual estimate of out-of-State anglers specific to this stretch of the river was taken from surveys conducted by NMDGF from 1997 thru 2001. The surveys identified that an average of 61.4 percent of anglers using the special trout waters and 11.4 percent using the regular regulation waters were from out of State. This percentage is applied to the angler day estimate (53,800) provided by the NMDGF.[52]

Currently, an annual direct expenditure of $11,026,000 in the local economy results from out-of-State river visitation, estimated at 27,565, by applying the Visitors Bureau-estimated $400 expenditure per out-of-State anglers (see Methodology section). Using guides' and outfitters' $462 estimate per trip (figure III-18) results in local annual expenditures of $12,735,000. Approximately $15,627,000 to $18,049,000 (direct, indirect, and induced impacts) to the local economy in total output occurs as a result of out-of-State anglers' fishing expenditures on the San Juan River in San Juan County, New Mexico.

The recreation section identifies the difficulty in predicting changes in recreation use because of the variable factors that affect angler use. However, if one were to assume that

[51] Personal communication with Farmington Visitors Bureau, February 2000.

[52] Estimates of angler use on the San Juan River are based on standardized pressure counts taken by NMDGF several times a month at 11 a.m. on any given day chosen for sampling.

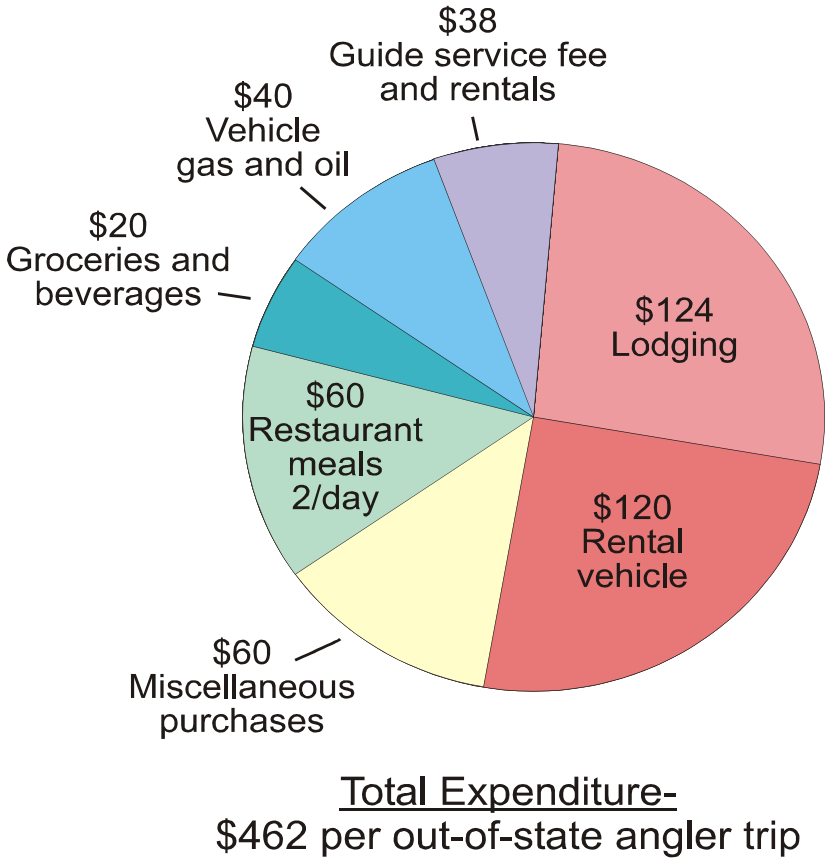


Figure III-18.—Total expenditure.

there is a linear correlation between recreation and trout habitat as suggested in the Recreation section of this chapter, the following range in losses in direct angler expenditures and associated indirect, induced, and employment impacts could be experienced in San Juan County.

Using the estimated reduction in angler use (described in the "Recreation" section) and applying the estimates of out-of-State anglers, losses in out-of-State angler use ranging from 2,800 to a maximum of 9,400 angler days could be expected to result in losses of $1.83 million to $6.16 million in total output and from 40 to 134 jobs for San Juan County, New Mexico. This amounts to less than a 1 percent reduction in the sectors of transportation, wholesale, and retail trade in the county, which would not be significant. However, these losses—when considered in smaller communities such as Navajo Dam or the larger City of Farmington–would be considered significant.

Accompanying a reduction in the number of anglers on the San Juan River there would be an impact on the revenues generated from the sale of both resident and non-resident fishing licenses by the NMDGF. Fishing license fees are as follows: annual resident, $17.50; annual nonresident, $39; 1-day resident or nonresident, $8; or 5-day resident or nonresident, $16.

Additional revenue would be lost to NMSP as a result of reduced sales of day-use permits and camping fees at managed sites and campgrounds along the river. Current day-use permits are sold for $4 each and overnight camping is $10 per night. Rough estimates of losses are difficult to determine because of a lack of data on license sales (resident, non-resident), the duration of the license (1 day, 5 day, or annual), and use permits. However, based on a range of from 10 to 34 percent loss in out-of-State anglers of 2,800 to 9,400 under the 250/5000 Alternative and using the $8 nonresident 1-day license fee and the $4-day use permit fee, approximately $22,400 to $75,200 in license fees and an additional $11,200 to $37,600 in day use fees (based on 1 day of fishing per angler) could be lost to the two State agencies.

Commercially guided fly fishers are a small component of San Juan River anglers and impacts to this group are included in the out-of-State fishing impacts because of a lack of specific data. However, commercially guided fly fishers do expend larger sums of money because their trips are not taken as frequently as those of local resident fly fishers and they may not travel with all the necessary fly fishing equipment.

San Juan River Rafting.—

Commercial Rafting Outfitters.—Most commercial rafting trips begin on the San Juan River approximately 4 miles west of Bluff, Utah, at the BLM's Sand Island campground and boat launching facility. A lesser number of trips originate at the Montezuma Creek launch site upstream from Bluff and from Mexican Hat, Utah. A total of 11 licensed outfitters are permitted (BLM) to commercially operate water craft on the San Juan River from Sand Island to the Clay Hills takeout. Trip lengths vary from single-day to 9-day float trips on the river. The small community of Bluff (population 320) is economically tied to the tourist, river, and land recreation industries and is somewhat dependent on those industries. Mexican Hat (population 600) is economically dependent in the same ways, but also has some income and employment from mineral extraction industries. Any change to these industries would have a significant direct impact on these small communities because outfitters, lodging, restaurants, and retail establishments are heavily dependent on river recreationists.

As discussed in the "Recreation" section of this chapter and based on BLM estimates, approximately 11,165 river users made an average of 1,225 boating trips, with about

9.1 boaters per trip.[53] BLM permit records indicate that commercial outfitters provided river trips for an estimated 3,908 river recreationists out of the total 11,165 river users during the 1999 season (May through September).

Private Boating.—Private river users are also an important component in the local economy. BLM permits issued to private boaters amounted to an estimated 7,257 river users in 1999.

Rafting Summary.—The analysis in the "Recreation" section in this chapter concluded that the overall quality of rafting would decline; however, current use figures are not projected to change during the core season of June, July, and August because demand at present far exceeds the supply of permits and attempts would be made to maintain flows above 500 cfs. Therefore, it is anticipated that there would not be a net economic impact to rafting.

Agriculture. —Favorable regional impacts for agriculture are significant under the 250/5000 Alternative that provides for future water development in the Basin. With the opportunity to develop future water supplies in the Basin, the NIIP could be fully developed. Cropping patterns on the currently developed lands consist of alfalfa, wheat, barley, corn, and potatoes. It is anticipated that these same crops would also be planted and in the same percentages on the undeveloped blocks. Based on these percentages and the acreage to be developed, estimates were made of the annual crop revenues that would be generated as a result of existing and future development.[54] Table III-22 displays the projected annual cropping pattern, acreage, and gross crop revenue to be generated by future development of NIIP lands.

[53] Use estimation numbers were obtained from permits issued to river recreationists by the BLM. River permits are restricted to 1,225 trips per year. User numbers are divided into commercial permits and private permits. Commercial permits are issued to licensed outfitters who arrange and provide raft trips for profit to the public; they comprise about 35 percent of the BLM trip permits issued each year, and were about 429 for 1999. Private permits issued to the public (who provide their own boats and necessary equipment) make up the remaining 65 percent of the permits issued, or about 796 permits. (A more detailed explanation of the permitting process is contained in the "Recreation" section in this chapter).

[54] Per acre revenues were determined based on New Mexico State University crop enterprise budgets representative of crop production in the area. Gross income per acre was multiplied times the acreage under current development of Blocks 7 and 8 and for future development of Blocks 9-11 to arrive at a total revenue generated which could then be applied to the agricultural production sectors of IMPLAN to determine the indirect and induced impacts to the region (San Juan County, NM).

Table III-22.—Additional crop revenues (gross) from completion of NIIP ($)

Crop	Acreage	Revenue/acre	Total revenue/crop
Alfalfa	8,420	618	5,203,251
Winter wheat	19,084	322	6,145,112
Corn	12,349	422	5,211,109
Dry beans	9,542	467	4,456,161
Potatoes	6,736	2,857	19,243,609
Total	56,130		40,259,243

Total output for San Juan County, New Mexico, would increase annually by an estimated $55,086,000, which is about 1.3 percent of the total county output. Additional income generated annually in the county is projected to be $14,488,000, which is about 1.2 percent of total employee compensation within the county, with an estimated increase in employment of 921, a 2 percent increase in total jobs. Positive employment impacts would be particularly beneficial to the Navajo Nation and the region, which has high unemployment.

500/5000 Alternative

It is anticipated that there would be limited positive impacts to the local economies of San Juan Counties, New Mexico and Utah, and Archuleta County, Colorado, with implementation of the 500/5000 Alternative.

Recreation/Tourism.— Because the minimum flows of 500 cfs are consistent with flows experienced during the last few years, minimal recreation-related economic impacts would be expected.

Agriculture.— This alternative would not meet the Flow Recommendations, so future agricultural development may be restricted. It could put NIIP (Blocks 9-11) in jeopardy because the reasonable and prudent alternatives for the NIIP (Blocks 9-11) as provided in the latest NIIP biological opinion could not be fully implemented.

Animas-La Plata Project (ALP Project).—Under the 500/5000 Alternative the planned development of ALP Project may not be able to proceed. This could result in possible loss of projected water development capital expenditures of approximately $227 million, not including construction costs for non-binding end uses. Unspecified losses

to non-Indian M&I water development would also occur. Specific details and estimates for non-completion of the ALP Project and the associated impacts to La Plata County, Colorado, can be referenced in the ALP Project FSEIS (Reclamation, 2000a).

Jicarilla Apache Nation Third-party Contract with PNM.— Under the 500/5000 Alternative, water provided by Jicarilla Apache Nation through their third-party contract with PNM could require ESA reconsultation. Impacts under this alternative would be the same as those under the No Action Alternative.

Other Socioeconomic Impacts

Socioeconomic impacts include monetary impacts for resources identified in other sections in this DEIS. Monetary impacts were identified in the "Diversion Structures," Water Quality," and "Hydropower" sections in this chapter.

Diversions

Water diverters along the San Juan River from the dam to the confluence of the Animas River may be economically impacted, but the overall impact would be much less than the impacts to other resources. Under the No Action Alternative, there would be no impacts. However, the 250/5000 Alternative (Preferred Alternative/Flow Recommendations) would require that impacted diverters expend up to a total of $16,000 or more each year to repair water diversion works, including cofferdams and headings of canals, damaged from high-flow releases up to 5,000 cfs from Navajo Dam. Under the 500/5000 Alternative, up to $7,000 or more each year would need to be expended to repair diversion works, including cofferdams and headings of canals, damaged from high-flow releases of up to 5,000 cfs from Navajo Dam (see "Diversion Structures" section in this chapter).

Water Quality

Low flows under the 250/5000 Alternative would also negatively impact Bloomfield's wastewater treatment plant's ability to meet water quality standards, resulting in the need to modify plant facilities and operations. Cost estimates for those modifications have not been made at this time and their significance is yet to be determined ("Water Quality" section in this chapter).

Hydropower

The reduction of flows in the San Juan River under the 250/5000 Alternative would result in the City of Farmington having to buy replacement power for generation lost at their hydro-generation power plant amounting to an annual average of $5.32 million based on a 10-year average of power replacement costs. This loss could expand to about $7.04 million annually if the power plant has to be taken out of service to prevent damage that would jeopardize the integrity of the equipment. Under the 500/5000 Alternative, cost of replacement power based on a 10-year average power replacement cost would amount to an estimated $3.16 million annually in expenditures by the city. Because of the magnitude of these replacement power costs, operation of the power plant under either of these alternatives may result in the City of Farmington having to increase rates to cover the loss in revenue or to replace or upgrade equipment at the Navajo Dam power plant for more efficient hydropower generation at lower flows through the penstocks.

SPECIAL STATUS SPECIES

This section addresses the potential impacts to special status species that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect special status species?

Overview

Scope

This scope includes special status species and their habitat along the San Juan River from the Navajo Reservoir area to Lake Powell.

Summary of Impacts

The No Action Alternative would adversely affect endangered fish species.

Under the 250/5000 Alternative, no substantial adverse effects are anticipated to threatened or endangered species or other special status species. There is the possibility of some impact under this alternative to the

southwestern willow flycatcher through the loss of riparian habitat along the San Juan River or from reservoir operations that stress such habitat around Navajo Reservoir.

Overall, endangered fish species, and native species such as the roundtail chub and the bluehead sucker would benefit from the alternatives that provide a more natural hydrograph; however, lower flows upstream from Farmington may adversely affect the roundtail chub and bluehead sucker in the San Juan River between the Hammond Project diversion and Farmington, under the 250/5000 Alternative, and water quality would occasionally be lowered.

The 500/5000 Alternative would provide less protection to endangered species than the 250/5000 Alternative.

Impact Indicators

For endangered fish, failure to acceptably meet the Flow Recommendations criteria would be considered as an adverse impact. For protected plant and terrestrial wildlife species, the indicators used to determine impacts include the presence and potential loss of a federally listed or candidate species, or loss or degradation of their habitat or their designated critical habitat.

Affected Environment

Special status species include threatened or endangered species officially listed and protected under the ESA and species of concern for which further information is needed to determine their conservation status.

The Service Region 2 (2001a) has provided the following list of endangered, threatened, and candidate species that could potentially be affected by the project alternatives:

Bald eagle (*Haliaeetus leucocephalus*)	Threatened
Interior least tern (*Sterna antillarum athalassos*)	Endangered
Southwestern willow flycatcher (*Empidonax trailii extimus*)	Endangered
Colorado pikeminnow (*Ptychocheilus lucius*)	Endangered
Razorback sucker (*Xyrauchen texanus*)	Endangered
American peregrine falcon (*Falco peregrinus anatum*)	Species of concern
Arctic peregrine falcon (*Falco peregrinus tundrius*)	Species of concern
Black tern (*Chlidonias niger*)	Species of concern
White-faced ibis (*Plegadis chihi*)	Species of concern

Yellow-billed cuckoo (*Coccyzus americanus*)	Species of concern
Roundtail chub (*Gila robusta*)	Species of concern
New Mexico silverspot butterfly (*Speyeria nokomis nitocris*)	Species of concern
San Juan checkerspot butterfly (*Euphydryas anicia chuskae*)	Species of concern
San Juan tiger beetle (*Cicindela lengi jordai*)	Species of concern

The Service Region 6 added the following species (Service 2001c):

Navajo sedge (*Carex specuicola)*	Threatened
Mexican spotted owl (*Strix occidentalis lucida)*	Threatened
Bonytail (*Gila elegans)*	Endangered
Humpback chub (*Gila cypha)*	Endangered
California condor (*Gymnogyps californianus)*	Endangered
Black-footed ferret (*Mustela nigripes)*	Endangered
Gunnison sage grouse (*Centrocercus minimus)*	Species of concern

The Navajo Nation (2001) has also provided a list of species of special concern that could occur within the impact area. Species include the golden eagle, bluehead sucker, mottled sculpin, southwestern willow flycatcher, peregrine falcon, roundtail chub, bald eagle, Colorado pikeminnow, northern leopard frog, razorback sucker, yellow-billed cuckoo, bighorn sheep, and alcove rock daisy.

The Service (1991a) concurred with a request from Reclamation that consultation on the operation of Navajo Dam and Reservoir under the ESA be extended while research was conducted on flow needs of endangered fish in the San Juan River. During the research period, which extended from 1991 to 1997, Reclamation provided research flows to mimic a natural hydrograph. Following the research period, a report on flow recommendations was prepared (Holden, 1999). A biological assessment on the effects of the Preferred Alternative on listed and special status species was prepared by Reclamation pursuant to the ESA and is included in Volume II of this DEIS. The Service will prepare a biological opinion on the Preferred Alternative and this will be included in the FEIS.

Threatened or Endangered Species

Colorado Pikeminnow and Razorback Sucker

The Colorado pikeminnow and razorback sucker are both endangered and native to the San Juan River. Critical habitat has been designated for both species on sections of the river

downstream from Farmington. A small reproducing population of pikeminnow occurs in the river downstream from Farmington; successful razorback recruitment has not been documented in the river in many years. Experimental stocking of both species began in the mid-1990s.

Colorado pikeminnow habitat extends from Lake Powell upstream to River Mile (RM) 158.4; primary use is between RM 119 and 148 (Service, 2000c). Five diversion structures between Farmington and the Utah State line were identified as potential barriers to fish movement in the San Juan River. Fish passage has been provided at the Hogback diversion and the Public Service Company of New Mexico's San Juan Power Plant diversion. Potential spawning areas have been located at River Miles 132 and 131.15 during radio telemetry studies. Successful reproduction was confirmed in the river in 7 years between 1987 and 1996 by the collection of larval and young-of-year pikeminnow (Service, 2000c). The populations of both species are being augmented by experimental stocking, and ponds have been established in the Basin to grow the fish to appropriate stocking size.

Small concentrations of razorback sucker have been reported in the inflow area in the San Juan arm of Lake Powell. One specimen was documented from the river near Bluff, Utah, but overall, this species is extremely rare in the San Juan River. Experimental stocking began in 1994 and these fish have been observed in spawning condition. Larval fish were collected between Bluff and Montezuma Creek (Service, 2000c). The razorback's current distribution in the San Juan River, including introduced fish, is from Lake Powell to near the Hogback Diversion (RM 158).

Loss of habitat, competition from non-native fish, and migration barriers may all be factors in the fishes' decline. Habitat of the fish in the San Juan River includes a complex mix of low-velocity habitats such as eddies, pools, and backwaters adjacent to swifter run and riffle habitats. A natural hydrograph (high spring flows, low base flows) is important in maintaining the habitat, and one of the main effects of Navajo Reservoir under historic pre-1991 operations has been to reduce high spring flows while increasing base flows. Spring peaks between 1963 and 1991 decreased by an average of 45 percent compared to pre-dam peak flows, while base flows increased. Also, habitat of the endangered fish species in the San Juan River was reduced when Navajo Reservoir and Lake Powell were filled in the 1960s, and reductions of water temperatures in the river due to releasing cold water from near the bottom of Navajo Reservoir may be a factor limiting recovery of the species.

The Flow Recommendations criteria are designed to benefit the endangered fish by addressing flow magnitude, duration, and frequency. The recommendations mimic the natural hydrograph with a peak in late May or early June followed by low base flows, and help maintain the complex habitats used by the endangered fish. Additional information on the fish and their needs is in the Flow Recommendations (Holden, 1999).

Bald Eagle

Bald eagles, which are a threatened species, occur around Navajo Reservoir and along the San Juan River, primarily as winter residents. No bald eagle nesting is known to occur in the New Mexico portion of the project area (Reclamation, 1999b) but an active nest occurs in Colorado on private lands north of Navajo Reservoir. Winter concentration areas occur around Navajo Reservoir and some of its tributaries. Winter concentration areas have been designated along the Piedra, San Juan, and Pine reservoir arms in Colorado, and in several areas around the reservoir in New Mexico. Food sources include fish and carrion. Night roost sites consisting of undisturbed cottonwood groves or ponderosa pine groves, from which eagles disperse daily for feeding, are important factors in maintaining wintering populations.

Southwestern Willow Flycatcher

The southwestern willow flycatcher is a small, migratory passerine bird that has lost habitat due to water diversion and flood plain channelization, introduction of non-native vegetation, livestock grazing, and nest parasitism by brown-headed cowbirds. The birds nest in dense riparian vegetation, with a nesting period from May through July. Potential habitat occurs along arms of Navajo Reservoir and along the San Juan River.

Figure III-19.—Southwestern willow flycatcher.

Along the San Juan River, habitat is dominated by tamarisk and Russian olive; native willow stands also occur. Studies reported by Johnson and O'Brien (1998) indicate that the lower river in Utah is primarily used by migrating birds and as such serves as an important stopover to replenish strength for the continued migration to breeding grounds. However, the river area does provide potential nesting habitat that may be used in the future.

In 1997, one nesting pair was documented along the San Juan in New Mexico downstream from Shiprock. Nesting was confirmed in this area again in 1998 but not in 1999 (BIA, 1999 and CUP, 2001). Migrating willow flycatchers have been observed along the river from Navajo Dam

downstream in New Mexico. Similarly, birds were observed along the Piedra arm of Navajo Reservoir in 1999 but were not confirmed to be nesting (Reclamation 1999b).

Interior Least Tern and Black Tern

The interior least tern is a small, migratory, piscivorus tern associated with shallow waters of lakes and rivers and is considered endangered. These birds are primarily found in the Mississippi Basin, although a breeding population occurs at Bitter Lake National Wildlife Refuge in Chaves County New Mexico. Nesting occurs in late May. The NMDGF reports infrequent sightings in San Juan County.

The interior least tern is not known to depend on the habitats along the San Juan River and Navajo Reservoir potentially affected by alternatives and thus should not be impacted.

The black terns would most likely be encountered in the project area during spring migration. Habitat includes lakes and reservoirs; nesting occurs in large cattail marshes adjacent to open water. Populations have been declining due to losses of habitat and possibly pesticides.

Species of Concern

Roundtail Chub and Bluehead Sucker

A small population of roundtail chub exists in the San Juan River downstream from Navajo Dam and also occurs in tributaries such as the La Plata and Mancos Rivers (BIA, 1999). The species also occurs in the San Juan River above the reservoir (Reclamation, 1999). Loss of habitat and competition from non-native fish are probably factors in their low populations in the San Juan River. Olson (1965) attributed low numbers to changes in water temperatures below Navajo Dam and early efforts to remove nongame fish from the river. Bluehead suckers tend to occur more frequently in the upper reaches of the San Juan River and occur both upstream and downstream of Farmington.

Mottled Sculpin

Mottled sculpin have been collected between RM 155 and 178 in the San Juan River and the species is common to abundant in the Animas River and tributaries upstream from Navajo Reservoir.

Gunnison Sage Grouse

The Gunnison sage grouse currently occurs in eight isolated populations in western Colorado and southeastern Utah. The species has been in decline, presumably due to habitat loss and fragmentation. Habitat includes large expanses of sagebrush with a diversity of grasses and forbs and healthy riparian areas.

American and Arctic Peregrine Falcon

These two species occur in Colorado and New Mexico, with nesting of the American peregrine falcon occurring in both States. There are no known nests around Navajo Reservoir (Reclamation, 1999b). Potential nesting habitat occurs on cliffs along the San Juan River, while riparian areas in the project region provide migration and foraging habitat.

Golden Eagle

The golden eagle uses a variety of habitats in the Basin, including the San Juan River corridor. Nesting occurs on cliffs or large trees. Primary foods include small mammals and carrion, although birds and fish can be included.

White-Faced Ibis

The white-faced ibis typically nests in colonies in dense marsh habitats and feeds in shallow water and flood-irrigated fields. Nesting does not occur in the impact area and the species is considered a casual migrant (BIA, 1999 and Reclamation, 1999b). However, nesting has been confirmed in Montezuma County, Colorado, just north of the impact area, indicating that nesting in the area is possible.

Yellow-Billed Cuckoo

The yellow-billed cuckoo would be considered a rare summer resident in the impact area. Populations have declined significantly throughout the species range; a major factor has probably been the loss of mature riparian forests. Loss of prey insects to pesticides is also believed to be a factor. Protection of riparian areas is critical to this species. Surveys of portions of the San Juan River in 1997 and 1998 indicated that the birds are present in small numbers during migration and there is some evidence of breeding (Johnson and O'Brien, 1998). Sites where birds have been observed generally consist of dense Russian olive, tamarisk, and willow with an associated stand or overstory of cottonwoods; no birds were

observed in sites with little vegetative understory. Factors that adversely affect populations along the river may include grazing, oil/gas exploration, and agricultural practices (Johnson and O'Brien, 1998).

California Condor

The California condor has been introduced to northern Arizona and may occur in the project area as a visitor.

Mexican Spotted Owl

The Mexican spotted owl inhabits canyon and montane forest habitats in a range that includes southern Utah, Colorado, New Mexico, and Arizona.

Northern Leopard Frog

The northern leopard frog is associated with wetlands and waterways along the San Juan River, including the extensive wetlands downstream from Navajo Dam.

Bighorn Sheep

Desert bighorn sheep can use the river for drinking and some use of riparian areas can occur, but overall this is a canyon and upland species. It is found along the lower river.

Black-Footed Ferret

There are no recent reports of black-footed ferret in the project area. Its potential habitat consists of grasslands and prairie dog towns.

New Mexico Silverspot and San Juan Checkerspot Butterflies and San Juan Tiger Beetle

These insect species are native species with limited distribution. Populations are affected by habitat losses and, in some cases, collection.

Navajo Sedge and Alcove Rock Daisy

The sedge has a specialized habitat of seeps-springs on sandstone cliffs in the lower end of the project area. The rock daisy is found in sandstone alcoves along the Colorado River in Utah.

Methodology

Existing literature on species was reviewed, including studies specifically conducted for Navajo Reservoir operations. Hydrologic modeling, described earlier in this chapter, was used to determine river flow changes, reservoir elevation changes, and the degree to which endangered fish Flow Recommendations criteria were met under the alternatives considered. Informal consultation was also conducted with Colorado and New Mexico wildlife agencies and with the Service.

Impacts Analysis

The sections below summarize information on special status species and their habitat in the impact area, and the results of impact analyses. Additional information is available in the biological assessment located in Volume II.

No specific mitigation measures are proposed for special status species. The Preferred Alternative is designed to create more natural river conditions that should have an overall benefit to these native species. The effects of changed flows and other recovery actions for the endangered fish would be monitored to determine if flow regimes should be modified in the future.

No Action Alternative

Under the No Action Alternative, river conditions would be similar to those that occurred from 1973-1991, and riparian habitat conditions would remain similar to those that presently occur. High spring flows to create and maintain endangered fish habitat would occur at a lower frequency and magnitude than needed for fish recovery. Table II-3 and figure III-2 show that this alternative would meet flow recommendation criteria significantly less than would the action alternatives. Potential benefits of cottonwood regeneration along the river would be reduced.

The Colorado pikeminnow, razorback sucker and other native fish would be adversely impacted under the No Action Alternative, and other species associated with riparian areas such as the southwestern willow flycatcher and yellow-billed cuckoo also may be negatively affected.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

As discussed in chapter II, it is anticipated that flexibility would exist during the irrigation season under this alternative. This would reduce impacts associated with low summer flows during an interim period; however, impacts discussed below would be expected to occur in the long term.

In general, the more natural hydrograph seen in the Preferred Alternative should support more natural conditions along the river, which would be favorable to native species that include special status species. Cottonwood regeneration should be maintained or improved by a slight degree, while scouring losses of riparian shrubs from island areas and some bank areas would also occur. Periods of very low flow upstream from Farmington in summer months under the 250/5000 Alternative (the Preferred Alternative) may stress riparian vegetation and wetlands associated with the river corridor; however, many of these wetland areas are supported by groundwater inputs from irrigation near the river that should not be adversely affected.

The southwestern willow flycatcher may be affected by loss of any riparian habitat along the San Juan River or by reservoir operations that stress existing riparian habitats that occur in reservoir inflow areas such as the Piedra and San Juan arms of the reservoir. Stresses on riparian vegetation between the dam and Farmington due to low flows would be greatest under the Preferred Alternative. Long-term effects on habitat due to a more natural hydrograph under the Preferred Alternative are more difficult to project, but high spring flows should have an overall beneficial effect on riparian areas and should discourage human encroachment.

The Colorado pikeminnow and razorback sucker would be affected by changes to Navajo Dam operations. The 250/5000 Alternative provides a more natural hydrograph than does the No Action Alternative, and thus would be expected to benefit the fish and their critical habitat by restoring more natural river function.

The Flow Recommendations criteria are designed to maintain and improve habitat for these fish. The degree to which an alternative meets the Flow Recommendations criteria is a good indication of which alternative would best meet the fishes' needs. Table II-3 and figure III-2 indicate that the 250/5000 Alternative meets or exceeds the Flow Recommendations criteria for peak flows, and target base flows would also be met under this alternative.

Water quality changes in the San Juan River are discussed earlier in this chapter. Under the Preferred Alternative, flow reductions to 250 cfs and future water development would tend to concentrate pollutants in the river, some of which are of concern to the fish including trace elements such as selenium and polycyclic aromatic hydrocarbons (PAHs). Simpson and Lusk (1999) studied contaminants in the river and concluded, however, that the

concentrations of contaminants in biota inhabiting the mainstem river were not consistently correlated with flow levels. Additional research is needed to determine the relationship between water quality and endangered fish recovery.

Of the special status species that are not officially listed as threatened or endangered, the roundtail chub, mottled sculpin and bluehead sucker are the most likely to be affected. The more natural hydrograph downstream from Farmington under the 250/5000 Alternative may benefit these species by providing more natural habitat conditions. Upstream from Farmington, adverse effects are possible because of reduced habitat associated with lower flows, but this would probably be more than offset by habitat improvements due to the high spring releases.

The bald eagle is not expected to be affected by the Preferred Alternative. A more natural hydrograph along the San Juan River should maintain and possibly enhance regeneration of cottonwood trees which are important winter habitat. In addition, the periodic high spring flows may discourage human encroachment into flood plain areas, indirectly benefitting the eagle's habitat. Increased river flows would cause more loss of mature trees to bank erosion, possibly offsetting this benefit. Food supplies in the waterways affected should not be adversely impacted.

Suitable habitat of the terns, peregrine falcons, golden eagle, white-faced ibis, Gunnison sage grouse, California condor, black-footed ferret, Mexican spotted owl, bonytail, humpback chub, bighorn sheep, and Navajo sedge should not be affected by the Preferred Alternative.

The Preferred Alternative is not anticipated to adversely affect the yellow-billed cuckoo. While the more natural hydrograph under the 250/5000 Alternative may scour some of the riverbank riparian areas, the flows also may be more conducive to maintenance and establishment of important cottonwood groves along the river.

Reduced summer flows between Navajo Dam and Farmington under the Preferred Alternative may adversely affect leopard frog habitat, particularly in the extensive wetlands just downstream from Navajo Dam.

The 250/5000 Alternative would have a net beneficial effect on the endangered Colorado pikeminnow and razorback sucker and would not adversely affect special status insect species, although a more natural riparian area along the San Juan River may be beneficial.

500/5000 Alternative

The 500/5000 Alternative would not fully meet the Flow Recommendations criteria for endangered fish species, as shown in table II-3 and figure III-2. Peak flows provided

under this alternative would provide better conditions than the No Action Alternative, but base flows would more frequently exceed the recommended base flow target range of 500-1,000 cfs below Farmington.

This alternative would have little effect on other species considered. Riparian species could benefit as this alternative would provide a more natural hydrograph than the No Action Alternative.

VEGETATION AND WILDLIFE RESOURCES

This section addresses the potential impacts to vegetation and wildlife resources that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect vegetation and wildlife resources, including wildlife habitat?

Overview

Scope

The analysis includes Navajo Reservoir and the following sections of the San Juan River: Navajo Dam to Archuleta, New Mexico; Archuleta to the Animas River confluence near Farmington, New Mexico; and the Animas River confluence to Lake Powell, Utah/Arizona.

Summary of Impacts

Under the No Action Alternative, few adverse impacts are projected to wildlife and no adverse impacts are expected for wetland/riparian vegetation associated with the reservoir or downstream from the dam.

Under the 250/5000 Alternative, no major losses of riparian habitat are expected, though long-term reduction in vegetation vigor may occur above the Animas River confluence. This potential loss would reduce riparian habitats for some wildlife species immediately downstream from the dam.

Under the 250/5000 and 500/5000 Alternatives, minor impacts could occur to riparian vegetation and supported wildlife habitat at reservoir inflow areas. Benefits to cottonwood regeneration may occur associated with a 5,000 cfs release, and may eventually provide habitat for wildlife.

Under the 500/5000 Alternative, the effects to riparian vegetation and wildlife habitat below the dam would be inconsequential.

Impact Indicators

For Navajo Reservoir, a rapid, long-term decline in reservoir elevation during the growing season would be considered an indicator of adverse conditions to wetland/riparian vegetation that supports wildlife habitat near reservoir inflow areas. Similarly, downstream from Navajo Dam, any long-term flow reduction below existing levels in the growing season could indicate an impact to water sources supporting riparian vegetation and associated wildlife habitat.

Affected Environment

Navajo Reservoir

Vegetation and wildlife associated with Navajo Reservoir are primarily supported by upland plant species dominated by stands of pinyon pine and juniper, which constitute the dominant vegetative mix associated with Navajo Reservoir. Other upland vegetation near the reservoir includes sagebrush, greasewood, Gambel oak, serviceberry, mountain mahogany and chokecherry (Reclamation, 1999b). Wildlife found in these areas includes large ungulates, mostly mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*); large carnivores, primarily mountain lions (*Felis concolor*); and small carnivores such as the coyote (*Canis latrans*) and bobcat (*Lynx rufus*).

Small mammals include the desert cottontail (*Sylvilagus audoboni*), black-tailed jackrabbits (*Lepus californicus*) and the locally common Gunnison's prairie dog (*Cynomis gunnisoni*); small birds (primarily passerines); and a number of reptile species including several species of lizards and snakes. Several raptors are also common, including the red-tailed hawk (*Buteo jamaicensis*), golden eagle (*Aquila chrysaetos canadensis*), American kestrel (*Falco tinnunculus*) and Swainson's hawk (*Buteo swainsoni*) (Reclamation, 1999b). The federally listed bald eagle (*Haliaeetus leucocephalus*) (threatened) is also commonly found, mostly during the winter.

Other limited wildlife habitats near or adjacent to the reservoir are composed of wetland/riparian vegetation that is locally abundant and associated with inflow areas, especially the Piedra and San Juan Rivers arms of the reservoir. Wetland/riparian vegetation within these two areas is composed of native willow and broad-leaf cottonwood trees. Salt cedar, an invasive non-native plant, rarely occurs in these areas. The Pine River arm of the reservoir supports some riparian vegetation but in much smaller numbers than in the other two arms. Broad-leaf cottonwood trees are the most common riparian plant found in this area of the reservoir. These habitats are occupied by numerous species of wildlife,

including many identified above. In addition, these are the areas in which it is likely to find neotropical birds species, numerous small rodents such as deer mice (*Peromyscus spp.*), and aquatic-loving mammals such as muskrat (*Ondatra zibethica*) and beaver (*Castor canadensis*).

Navajo Reservoir also supports habitat for a variety of waterfowl, including Canada Geese, (*Branta canadensis*) mallard duck (*Anas platyrhynchus*), common merganser (*Mergus merganser*), American coot (*Fulica americana*) and common goldeneye (*Bucephala clangula*). Waterfowl are far more common during the fall and winter and are also more concentrated near inflow areas.

San Juan River

Navajo Dam to Archuleta, New Mexico.—This 6.6-mile stretch of river between Navajo Dam to Archuleta supports an important wetland/riparian zone providing habitat to numerous wildlife. Many of the wildlife species listed above can also be found downstream of Navajo Dam. This portion of river is also unique in that it maintains several wetland areas, especially within the first two miles downstream of the dam. Excavations for material for Navajo Dam created low areas connected to the river that have developed into an extensive wetland. This wetland complex, composed of willows, cattails, salt cedar and several less common wetland and riparian plants, supports a unique ecosystem allowing for several wildlife species to thrive that are otherwise not found in the area, due primarily to the warm water conditions provided in the summer. The northern leopard frog (*Rana pipiens*) is an example of a species benefitting from this limited habitat as it is commonly found within this wetland but is otherwise extremely rare on the river. Also commonly found within this wetland are beavers and muskrats. In addition, this wetland complex supports habitat, including breeding and nesting habitat, for numerous species of waterfowl, including the species identified as using Navajo Reservoir. Other species of waterfowl identified within this section of river are ring-billed gull (*Larus delawarenis*), gadwall (*Anas strepera*), northern pintail (*Anas acuta*), American widgeon (*Anas americana*), green-winged teal (*Anas crecca*) and bufflehead (*Bucephala albeola*) (Reclamation, 1998).

Numerous raptors are also commonly found along this section of river, including the bald and golden eagles and the red-tailed hawk. Migrating willow flycatchers (*Empidomax traillii*) and other neotropical birds have also been seasonally identified utilizing this portion of the river. Other wildlife commonly found within this reach are the mule deer and, to a lesser extent, elk.

Archuleta to the Animas River.—Most of this section of river is in private ownership, and significant areas have been cleared of wetland/riparian vegetation, thereby reducing wildlife habitat, to allow for the expansion of agriculture, ranching, and commercial development. Numerous diversions deplete river flow throughout this reach,

the greatest impact occurring during the irrigation season. Flow depletions from the river would have an adverse effect on riparian vegetation by lowering the water table. This effect, however, is more than offset by the positive effect irrigation return flows have on elevating groundwater levels in many areas between where the water is used and the river.

Wetland/riparian vegetation existing along the San Juan River throughout this reach includes broad-leaf cottonwoods, willow, salt cedar and Russian olive. While there remain extensive riparian areas, wildlife quantity and diversity are very limited because of human intrusion. Still, there are some wildlife species that have benefitted, including beaver, striped skunks (*Mephitus mephitus*), raccoon (*Procyron lotor*), muskrat, and other small mammals. Deer are also fairly common, having become acclimated to human presence. Most of the animal species identified as occurring in the upper section of the river occur through this reach as well, but, for the most part, in lower numbers.

***Animas River to Lake Powell.*—**This 180-mile section of river maintains the most natural hydrologic conditions in the San Juan River downstream of Navajo Dam, primarily because of the influence of the Animas River, which is largely unregulated. This section of river supports areas of riparian vegetation of varying size; the extent is largely dependent on historic and ongoing land use practices. Overgrazing by livestock is one of the major factors adversely impacting riparian vegetation. Over the last 100 years, much of the native vegetation has been displaced by non-native vegetation. As the river flows downstream, non-natives become more prevalent, with Russian olive becoming the most common riparian plant found along the river. Salt cedar is also common, with willows and broad-leaf cottonwoods found less commonly. Natural recruitment by cottonwoods appears to be rare, while large, decadent cottonwood trees are infrequently found, most typically located well away from the existing channel and many times associated with intermittent flowing arroyos.

Wildlife utilizing riparian areas associated with the river are limited because of the lack of habitat diversity and the impact of over-grazing within a large percentage of the riparian zone. Many of the wildlife species identified above can be found within this section of river, but in reduced numbers. The riparian zone does likely provide a bridge allowing for the seasonal migration of neotropical birds to upstream breeding areas (this would include the federally protected southwestern willow flycatcher).

Methodology

Existing literature on wildlife resources associated with Navajo Reservoir and the San Juan River was used to obtain pertinent, useful information. Vegetative communities associated with Navajo Reservoir have been generally identified and quantified by using satellite imagery (Reclamation 1999b). Wetland/riparian vegetation mapping of the San Juan River

was done in 1996-97 from Navajo Dam to Archuleta (Reclamation, 1998). These data were used, in part, to infer habitat types that are known to support numerous wildlife species. Also, a limited waterfowl study was done during the 1996-97 Winter Low Flow Test documenting the seasonal use of the San Juan River by waterfowl and shore birds. In addition, wildlife use on the river was estimated based on field observations from Navajo Dam to Farmington.

Impacts Analysis

Navajo Reservoir

***No Action Alternative.*—**Under the No Action Alternative, reservoir levels would remain higher throughout the growing season (April - October) as compared to the action alternatives (see figure II-3). This would benefit wetland and riparian areas that have developed in the inflow areas of the reservoir such as the Pine River and San Juan arms. These higher levels would help maintain existing wildlife habitat.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations).— Reservoir levels would average 10 feet lower during the growing season under this alternative. The reduced water levels could adversely affect wetland/riparian vegetation and associated wildlife habitats in the inflow areas discussed above. This alternative would also be less beneficial than the No Action Alternative to the establishment of cottonwood trees around the reservoir perimeter.

***500/5000 Alternative.*—**Impacts would be similar to those of the 250/5000 Alternative, although reservoir fluctuations would be greater as larger minimum releases would be maintained from the dam. As with the 250/5000 Alternative, wildlife habitat in reservoir inflow areas could be adversely impacted.

San Juan River

No Action Alternative.—

Navajo Dam to Archuleta, New Mexico.—Under the No Action Alternative, there would be few effects on wildlife resources in this reach of the river. Higher year-round flows would continue to supply water to the valuable wetlands in the first few miles downstream from Navajo Dam. In the long term, reduced high spring flows could impair regeneration of cottonwoods that are valuable to wildlife.

Archuleta to the Animas River.—Few impacts to vegetation supporting wildlife habitat would occur under the No Action Alternative. Higher base flows might be beneficial; however, reduced spring flows could result in less cottonwood regeneration and more encroachment into the flood plain by human activities.

Animas River to Lake Powell.—Animas River flows would help provide a more natural hydrograph in this reach, benefitting the riparian areas and the wildlife they support, although benefits would be less than under the action alternatives.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations).—As discussed in chapter II, there is anticipated flexibility in summer releases under the 250/5000 Alternative. This could reduce impacts in an interim period; however, impacts discussed below are expected to occur in the long term.

Navajo Dam to Archuleta, New Mexico.—The wetland riparian vegetation providing wildlife habitat along this section of river is most likely entirely tied to the river for its water supply. During the Winter Low Flow Test, this section of river was monitored to assess changes in water surface elevations associated with a flow reduction from the dam from 500 cfs to 250 cfs. The reductions associated with a 250 cfs release were relatively small; however, any long-term change in hydrologic flow regimes could result in both a potential reduction in the wetland/riparian quantity and quality. The kinds of impacts that would result would likely occur over several years after long-term reductions in flow below 500 cfs occurred during the growing season. It is unlikely that any major loss of riparian wildlife habitat would occur from implementing the 250/5000 Alternative; nevertheless, the large wetland complex located within the first 2 miles below the dam would be the single largest concern because of its total reliance on the river's hydrology. However, while releases from Navajo Dam would be as low as 250 cfs under the 250/5000 Alternative, these releases would not occur all the time. Flow releases throughout any given year would be variable and would range from 250 to 900 cfs as needed to meet target flows downstream from Farmington. No adverse long-term impacts to wetlands or wildlife are anticipated.

Archuleta to the Animas River.—This 37-mile stretch of river would probably not be impacted by reduced releases from the dam in that much of the riparian area providing wildlife habitat is supported by return flows. The specific wetland/riparian areas that are supported by hydrology other than the river have not been identified. Still, it is likely that once long-term releases of flow below 500 cfs were implemented, there would eventually be a reduction in the riparian area in some areas that rely on the river's hydrology for growth and maintenance. Higher spring flows may improve cottonwood regeneration in this reach and downstream.

Animas River to Lake Powell.—This section of river is not likely to be adversely impacted by implementing the 250/5000 Alternative. The influence of the unregulated Animas River below its confluence with the San Juan River would effectively offset the effects of reduced releases from Navajo Dam.

500/5000 Alternative.—

Navajo Dam to Archuleta, New Mexico.—Impacts would be similar to those of the 250/5000 Alternative; however, higher summer flows could reduce impacts to wetlands in the upper end of this reach.

Archuleta to the Animas River.—Impacts are not expected to occur.

Animas River to Lake Powell.—Impacts would be similar to those of the 250/5000 Alternative, although spring flows would occur for shorter periods. This would result in fewer beneficial effects to riparian area; however, the overall impact would be inconsequential.

LAND USE

This section addresses the potential impacts to land use that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect land use?

Overview

Scope

The scope includes lands in use from Navajo Dam and Reservoir downstream along the San Juan River to Lake Powell.

Summary of Impacts

Under the No Action Alternative, future development of NIIP and other water projects might not occur.

Under the 250/5000 Alternative, ESA compliance would be in place to allow future development of NIIP.

Under the 500/5000 Alternative, there may not be full development of NIIP.

Impact Indicators

Adverse effects on the use of lands within the impact area.

Affected Environment

Navajo Reservoir

Lands under the jurisdiction of Reclamation around and below Navajo Reservoir are jointly managed by State and Federal agencies for multiple uses, including mineral extraction, grazing, wildlife, and recreation. In New Mexico, most of the land adjacent to the reservoir and outside of the Navajo State Park is managed by BLM. Recreation-based lands within Navajo State Park are managed by the CDPOR and NMDPR.

Other public lands adjacent to the reservoir include State lands managed by NMDGF and New Mexico State Land Office; in Colorado, Southern Ute Indian lands are managed by the Tribe. Private lands border much of the Navajo Reservoir boundary in the Arboles, Colorado, vicinity and most of these lands remain in agriculture, with some developed as rural residential areas.

Current use of the area is predominantly for agriculture and recreation. Flood plain development is limited, based on governmental guidelines.

Indian Reservations

Navajo Nation Lands comprise the largest Indian reservation holdings within the study area. The latest Navajo Reservation Land Use Plan is dated March 2, 1961, and primarily inventories physical features, conditions, and resources at that time. An updated Land Use Plan is in progress but not ready for public release.

The Southern Ute Indian Reservation borders Reclamation lands on the Colorado side of Navajo Reservoir and the north end of the San Juan River. The Ute Mountain Ute Tribe has a small portion of land within the river corridor in the Four Corners area in Colorado.

San Juan Corridor

The San Juan Corridor is composed of various land uses including recreation, agriculture, grazing, oil and gas development, fish and wildlife, and other uses. Ownership is a mixture of Tribal, Federal, and private.

Methodology

Contacts were made with various State, county and local governmental agencies and Indian Tribes to discuss land use impacts from implementation of the No Action and action alternatives.

Impacts Analysis

Land use along the San Juan River within the impact area should not be affected by change in river flows under the No Action and action alternatives.

No Action Alternative

Under the No Action Alternative, land use activities are expected to remain within historical use, and no adverse impacts are projected except those identified under the "Socioeconomics" section in this chapter regarding completion of NIIP.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

Under the 250/5000 Alternative, ESA compliance would be in place to allow future development of NIIP.

500/5000 Alternative

Under the 500/5000 Alternative, full development of NIIP may not occur.

CULTURAL RESOURCES

This section addresses the potential impacts to cultural resources that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect cultural resources?

Overview

Scope

The area of potential effect for Navajo Reservoir operations is within what is informally known as the Navajo Reservoir Archaeological District[55]. Because the alternatives would not result in any adverse alterations of channel conditions downstream of the dam outside of the existing flood plain, the area of potential effect for cultural resources is limited to Reclamation's administrative boundary at and around Navajo Reservoir. It also does not include the inactive storage area in the reservoir, since standard reservoir operations rarely result in water levels lower than inactive storage.

Summary of Impacts

There would be short- and long-term impacts to cultural resources within the reservoir area as a result of implementing any of the alternatives (No Action, 250/5000, and 500/5000 Alternatives). However, none of the alternatives are likely to alter the flow regime in the San Juan River downstream of the dam to the point that riverbank cultural resources would be impacted.

Impact Indicators

For cultural resources, a historic property is defined as one that meets one or more of the eligibility criteria for the National Register of Historic Properties (NRHP). These include prehistoric or historic archaeological sites or properties of historic interest or cultural significance to a community or ethnic or social group. These impacts would be considered adverse if they occurred

[55] This is not a National Register District since the archaeology was done prior to passage of the National Historic Preservation Act (NHPA).

to cultural resource sites that were protected under the National Historic Preservation Act of 1966, as amended in 1992 (NHPA),[56] the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA), or Executive Order 13007, Protection of Native American Sacred Sites.

A significant environmental effect would occur if the action would disrupt or adversely affect eligible historic properties[57]. Adverse impacts to cultural resources include destruction, disturbance, inundation or vandalism.

Affected Environment

A study area was identified for salvage archaeology considerations for the construction of Navajo Dam. Surveys and excavations were conducted to mitigate the construction and filling of Navajo Reservoir between 1956 and 1962. At the time, the excavations constituted one of the largest mitigation projects ever conducted for a water project in the United States[58]. It yielded a contribution to the understanding of the prehistory and history of the area, resulting in the definition of a cultural sequence which now extends well beyond the reservoir itself. Known cultural traditions at the reservoir include the Archaic Period (3000 to 500 B.C.), several phases of the Pueblo Period (A.D. 1-1050), the Protohistoric/Early Historic Period (A.D. 1450-1870) and Euroamerican settlement (A.D. 1765-1960).

Cultural resources are physical or other expressions of human activity or occupation, including culturally significant landscapes, prehistoric and historic archaeological sites and isolated artifacts or features, historic structures, human burials, sacred sites, and traditional cultural properties (TCPs). TCPs are sites or areas of important cultural value to existing communities, and may not have actual physical remnants associated with their existence. Cultural resources that are eligible for inclusion in the NRHP are protected under the NHPA. Cultural resources may also be protected under the NAGPRA and Executive Order 13007, and other State, agency, or Tribal laws and policies.

Known cultural traditions in the project area are as follows:

[56] It should be noted that, while significant impacts to cultural resources may be "resolved" through data recovery in compliance with applicable regulations and guidelines, such resolution would not reduce impacts to less-than-significant levels. As such, significant impacts which may be resolved would remain adverse.

[57] Sites within the Navajo Reservoir boundary have not been evaluated to determine their eligibility status. As a result, the impact analysis will assume that all sites may be eligible.

[58] Cultural resource mitigation was completed prior to passage of NHPA and emphasized cultural sites below the inactive zone of the reservoir.

Archaic

The Archaic period in the region is typified by a change from a big-game hunting emphasis to the hunting of smaller game and the intensive collection of plant foods. Most sites of this period date between 6000 B.C. to A.D. 1.

Pre-Puebloan and Puebloan

The majority of sites at the reservoir date to this time period.

The Basketmaker II period is characterized by the adoption of structures and features for habitation and storage of surplus foods. Basketmaker culture was named for its finely woven baskets and lack of pottery. Basketmaker II sites appear to date between A.D. 200 and 400.

The Basketmaker III period (A.D. 400 to 700) marks the beginning of a more sedentary agricultural lifestyle and the use of ceramics and adoption of the bow and arrow. This period also represents the beginnings of the typical Anasazi (Ancestral Pueblo) site layout.

The Pueblo I period (A.D. 700 to 900) is well represented with small hamlets scattered across the project area. It is during this period that surface structures, identified as pueblos, become increasingly common.

The Pueblo II and Pueblo III periods (A.D. 900 to 1300) are characterized by larger pueblos which usually include masonry roomblocks and larger semi-circular pit structures, called kivas. These are the ruins familiar to most modern visitors to the area, such as the sites on display at Mesa Verde National Park. The Pueblo III period is poorly represented in the Navajo Reservoir District and is the last vestige of Puebloan occupation in the area.

Protohistoric/Early Historic

Three contemporary Indian Tribes have trust lands in close vicinity to Navajo Reservoir. The Navajo, the Jicarilla Apache, and the Southern Ute began occupying the lands in and around Navajo Reservoir as early as the 1400s. Most of the sites at the reservoir of this time period are attributed to the Navajo.

The Navajo occupation of the Navajo Reservoir District is divided into three basic time frames: the Dinetah, Gobernador, and the Post-Gobernador. The Dinetah Phase applies to the era of the earliest Athapaskan-speaking groups. While the present-day Navajo consider the Navajo Reservoir District as their homeland (from which the name Dinetah is derived), archaeologists believe the Athapaskans entered the region in the 1400s and occupied the

area for about 250 years. The Gobernador Phase applies to the area of acculturation following the Spanish reconquest of the region from 1692 through 1696, after the Pueblo Revolt of 1680. In the late 17th century, the Gobernador Navajo left the region, and they apparently did not re-enter the area until the Post-Gobernador period (mid-1800s), by which time the Navajo had fully adapted a pastoral lifeway. In 1868, a treaty was signed (and amended in subsequent years) which established the Navajo Indian Reservation immediately west of the Navajo Reservoir District.

The Jicarilla Apache are also Athapaskan speakers and their ancestors in the area may derive from the same stock as Dinetah phase. Their homeland is identified as the area extending between the Arkansas and Chama river valleys to the north and east of Navajo Reservoir. By 1700, the group distinguishable as the Jicarilla Apache had emerged. Beginning in 1874, an executive order was issued which set aside several reservations for the Jicarilla Apache, one of which included a portion of the present Navajo Reservoir. However, the Jicarilla never took up residence there. In 1887, an area immediately east of Navajo Reservoir eventually became what is now the Jicarilla Apache Nation Reservation.

Very little is known of the antiquity of the Colorado Ute Tribes. It is possible that the first Shoshonean speaking groups (of which the Utes are a part) entered southwestern Colorado as early as the 1200s from the north and west, coinciding with the Puebloan departure from the area. The first historical references to the Utes (from Spanish explorers) date to 1626, at which time their range extended to parts of northwest New Mexico. In the 1870s, the Southern Ute Indian Reservation (since divided into the Southern Ute and Ute Mountain Ute Indian Reservations) was established, and includes the Colorado side of Navajo Reservoir. In the 1960s, the Federal Government withdrew some Southern Ute Reservation lands for Navajo Unit project purposes.

Euroamerican Historic

By 1765, Spaniards from New Mexico settlements had visited the Navajo Reservoir region. In 1776, the Dominguez-Escalante expedition passed by what is now the upper end of Navajo Reservoir. In the decades following, Spanish and Mexican traders opened a trade route to California, known as the Old Spanish Trail, which follows the Dominguez-Escalante route through the project area. The trail continued to be used until 1848.

Beginning about 1870, emigrants of Hispanic descent began establishing settlements in the Navajo Reservoir region, including the towns of Rosa and Arboles. In the 1880s a railroad line was constructed through the area which connected Chama, New Mexico, to Durango, Colorado. However, in the 1950s, the towns and the railroad were abandoned in

preparation for the filling of Navajo Reservoir. While mostly beneath the waters of Navajo Reservoir and/or having been removed at the time of abandonment, some remnants of the Euroamerican historic period can still be observed.

Traditional Cultural Properties (TCPs)/Native American Graves Protection and Repatriation Act (NAGPRA)

Research conducted indicates that a number of Native American Tribes have ancestral and contemporary ties to the area. Archaeological data provide some information about prehistoric and historic aboriginal use of the region; however, each Tribe has its own account of the Tribe's traditional use of the area. Of the 15 Tribes consulted, 11 (Hopi, Jicarilla Apache, Navajo, Jemez, Nambe, Pojoaque, San Ildefonso, Santa Clara, Taos, Laguna, and Southern Ute) have expressed concerns and requested to be included in further consultations. The remaining four (Zuni, Tesuque, San Juan, and Picuris) have either stated they have no concerns or have not responded despite a good faith effort to consult. All 15 Tribes will be provided with the DEIS.

While direct evidence for the existence of burial sites in the area is lacking, knowledge of the cultural resources indicates a high likelihood of encountering human remains during archaeological excavation or construction activities. Burials on Puebloan archaeological sites are rather common and are to be expected.

Methodology

The No Action, 250/5000, and 500/5000 Alternatives were analyzed for their potential impacts at the reservoir according to hydrological projections (Alpine Archaeological Associates, 2000). Much of what follows is derived from those projections.

In a numerical ranking included in this section, the No Action and action alternatives are given scores which represent a crude index derived from the number of times that water is at a given elevation times the number of sites corresponding to that elevation (including an estimate that 40 percent of the sites are eligible) since wave action is the single most impacting factor affecting sites at reservoirs. Other factors, such as human impacts, are difficult to quantify and therefore are not a part of the index. A higher score equals higher impact to the resource.

Impacts Analysis

Many archaeological sites remain below the high water level of Navajo Reservoir, and are subject to exposure and impacts in the case of drawdown. The operation of Navajo Dam changes the water level in the reservoir, resulting in shore bank exposure which leaves the

banks susceptible to increased wind and water erosion and vandalism. Archaeological, historical, and traditional cultural resources are exposed and impacted as a result.

Hydrology analysis predicts the reservoir elevations would reach approximately 6,010 feet on a periodic basis, with the potential to be as low as 5,975 feet in extreme low water years. The frequency at which these levels would occur varies by alternative. Human activity around the reservoir is expected to continue and probably to increase over time, resulting in additional impacts to cultural resources. The alternatives are not likely to alter the flow regime in the San Juan River (downstream of the dam) to the point that riverbank cultural resources would be impacted.

A total of 143 archaeological sites, at one time or another, have been recorded within the drawdown zone[59] of Navajo Reservoir. Of those, two sites have been officially determined eligible to the NRHP, 117 are categorized as "need data"[60], nine are categorized as "field eligible"[61], and 15 have been categorized as "field not eligible"[62]. The sites range from prehistoric/protohistoric artifact scatters to historic house foundations. The most common site types are Pueblo I and Pueblo II habitations (about 40 percent of the total site base). These typically contain masonry room blocks associated with pit structures.

Investigations by Reclamation in 1987 and 1992 (Alpine, 2000) have indicated that these sites are likely to have retained much of their integrity (especially pit features) but that integrity is presently being compromised to varying degrees due to wave action and exposure. Based on this, official eligibility determinations have yet to be conducted, however, it is assumed that for purposes of discussion, a fair proportion of sites are eligible for inclusion to the NRHP.

No Action Alternative

Impact score: 4,042

The No Action Alternative would result in net impacts similar to those experienced from 1973-1991. A total of 106 known archaeological sites would be impacted in the drawdown zone, which ranges from 6,084 feet to 6,016 feet in elevation. The hydrology model indicates that water releases under this alternative would not result in levels as low as those identified under the action alternatives. Except in low water years, the typical pool

[59] The drawdown zone is approximately the 100-foot upper level of the reservoir, ranging from an elevation of 6085 to 5985 feet.

[60] Additional data are needed to determine eligibility to NRHP.

[61] Archaeologists in the field believe the site was eligible to the NRHP, but a determination was not made by the State Historic Preservation Officer (SHPO).

[62] Archaeologists in the field believe the site was not eligible to the NRHP, but a determination was not made by the SHPO.

elevations for the No Action Alternative fluctuate roughly between 6,080 feet and 6,060 feet. The high impact score reflects the relationship between the site density within a relatively narrow fluctuation zone and the number of fluctuations within that range. It may also be reflective of the fact that more archaeological surveys have been conducted in that zone.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

Impact score: 3,539

The 250/5000 Alternative has a drawdown zone of 6,085 feet to 5,987 feet, and would impact a greater elevation range and a greater number of sites compared to the No Action Alternative. Except in low water years, the typical pool elevations for this alternative would fluctuate roughly between 6,080 feet and 6,045 feet. As compared to the No Action Alternative, pool elevation would fluctuate more widely, resulting in less wave action within narrow elevation zones. As a result, wave damage is more dispersed among a larger set of archaeological sites; thus, the total impact would be less than that for the No Action Alternative. A total of 132 known sites would be impacted.

500/5000 Alternative

Impact score: 3,846

The drawdown zone for the 500/5000 Alternative is 6,085 feet to 5,975 feet, which is the largest range of pool elevations of all the alternatives. Except in low water years, the typical pool elevations for this alternative would fluctuate roughly between 6,080 feet and 6,035 feet. Consequently, this alternative would affect the largest number of sites: 141 sites. The impact index reflects that, although more sites would be exposed under the 500/5000 Alternative, the overall impact would be slightly less than that for the No Action Alternative because less wave action would occur in high site-density areas.

Summary

Both the 250/5000 and 500/5000 Alternatives would slightly reduce impacts of wave action (by 12 percent and 5 percent, respectively) from the No Action Alternative. However, this would be offset by increased total numbers of sites exposed in the drawdown zone that would be subject to vandalism. As a result, all of the alternatives, to varying degrees, would result in adverse impacts to cultural resources. This is not a result of the Preferred Alternative; rather, it is characteristic of dam operation in a high site density environment. For this reason, a programmatic, long-term, response to the general operation of Navajo Dam (regardless of the alternative selected) is proposed rather than specific mitigation measures tied to the proposed action.

It is proposed that a Cultural Resource Management Plan (CRMP) be prepared. Prior to the development of the CRMP, certain baseline data concerning the means necessary to either preserve sites or to mitigate impacts needs to be collected. The initial steps and the provisions of the CRMP are to be developed by Reclamation as a part of its resource management planning efforts[63] rather than a part of the DEIS. In brief, the programmatic approach is to include the following steps:

(1) Inventory and Evaluation: Complete an inventory of the entire typical drawdown zone (roughly defined as the 6,040 foot level and above) at the reservoir. This would include: a Site Significance Evaluation, which determines each site's condition and eligibility to the National Register; an Assessment of Threat, which determines any eligible site's nature and immediacy of possible threats from reservoir operation; and a Ranking of Site Value, which assesses site values with other sites identified in the Inventory.

(2) Preservation Assessment: Determine a site-specific treatment approach to decide on the most practical approach to preservation and/or mitigation at a given site.

(3) CRMP Preparation: Develop a plan that will detail the management of historic properties affected by reservoir operations. It will focus on specific sites and the most appropriate treatment measures as a result of steps 1 and 2.

(4) Implement Site Treatment: In this step, the site treatment plans established in the CRMP will be undertaken.

(5) Monitoring: Periodically monitor sites in the drawdown zone (by qualified archaeologists) to ensure that treatment measures are effective.

Under NAGPRA, Reclamation is consulting with interested and concerned American Indian Tribes/Nations. Tribal representatives include elected officials, recognized traditional and religious leaders, Tribal representatives and historians, and cultural committees. In addition, a draft NAGPRA Plan is being prepared with regard to potential effects dam operations may have on Native American human remains, associated grave goods, and objects of cultural patrimony. A Draft Programmatic Agreement will be prepared pursuant to the NHPA.

[63] Reclamation is preparing a Resource Management Plan for Navajo Reservoir that will address cultural and other resources.

FLOOD CONTROL

This section addresses the potential impacts to flood control that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect flood control along the San Juan River?

Overview

Scope

The flood control analysis includes the flood plain of the San Juan River downstream from Navajo Dam.

Summary of Impacts

Under the No Action Alternative, no adverse impacts to the downstream flood plain are predicted.

Under the 250/5000 and the 500/5000 Alternatives, the operation of the reservoir would include higher spring releases (5,000 cfs). These action alternatives have the potential to increase flooding downstream during spring releases, if high precipitation events occur concurrent with peak releases from Navajo Dam. As a result, adjustments to keep flows within channel capacity would be more difficult.

Impact Indicators

Safe channel capacity has been determined by the Corps to be 5,000 cfs for the San Juan River below Navajo Dam. Flows above the safe channel capacity would be considered an adverse impact.

Affected Environment

Flood control is an authorized purpose of the Navajo Unit, and the reservoir is currently operated to prevent flooding. The Corps has flood control authority downstream of the dam and has developed a water control manual for Navajo Dam. The manual provides flood control guidance by limiting rates of water flow in specified sections of the

San Juan River. It also designates reservoir water levels before and during the spring runoff in high water years. Before 1991, the dam was operated to stabilize river flows by reducing spring high flows and increasing summer, fall, and winter low flows.

By letter dated December 5, 2001, the Corps notified Reclamation of its determination that the current safe channel capacity for the San Juan River from Navajo Dam to the Animas River confluence at Farmington is 5,000 cfs.

Methodology

Existing data were used to assess impacts on flood control associated with each alternative and to determine whether alternative Navajo Dam operations would result in flows exceeding safe channel capacity.

Both Corps and Reclamation procedures were used in this analysis. Reclamation's procedures included review of its annual operating plan for the dam. This operating plan was modified to fall within the Corps' operating guidelines. Hydrologic modeling was used to assess anticipated changes to the riverflows and reservoir water levels.

Impacts Analysis

No Action Alternative

No adverse impacts to the downstream flood plain are predicted under the No Action Alternative.

250/5000 Alternative (Flow Recommendations) (Preferred Alternative)

Under the 250/5000 Alternative, the operation of the reservoir would include higher spring releases (5,000 cfs) and lower summer, fall, and winter releases. This action has the potential to increase flooding downstream during spring releases, if high precipitation events occur concurrent with peak releases from the dam. As a result, adjustments to keep flows within channel capacity would be more difficult. Under this alternative, fall spike releases for flood control would require careful coordination, timing, and planning among the Corps, Reclamation, the National Weather Service, and local entities or groups to avoid possibly causing flooding or other impacts from the dam releases.

500/5000 Alternative

Under the 500/5000 Alternative, impacts similar to those of the 250/5000 Alternative would occur.

NAVAJO DAM OPERATIONS AND MAINTENANCE

This section addresses the potential impacts to O&M that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect O&M activities at Navajo Dam?

Overview

Scope

The scope includes reservoir levels and proposed changes in operations at Navajo Dam and Reservoir.

Summary of Impacts

The No Action, 250/5000, and 500/5000 Alternatives would have minimal impact on O&M.

Impact Indicators

Impacts could be considered adverse if predicted reservoir levels and releases exceeded the design capability of Navajo Dam.

Affected Environment

Current O&M activities at Navajo Dam are performed in accordance with the dam's standing operating procedures. The dam's designed capability is not exceeded under present operations.

Methodology

All impacts were evaluated using the following criteria:

- ❑ Interviewing the reservoir superintendent, Reclamation O&M staff, and emergency, local, State, and Federal water officials.
- ❑ Examining the hydrologic modeling results for reservoir water surface elevations and releases under the alternatives considered and comparing them to historical reservoir records.

Impacts Analysis

No Action Alternative

Analysis of hydrologic studies for the No Action Alternative showed the predicted reservoir levels were within historic fluctuations and flow releases would be well within the designed capability of the dam. Accordingly, there would be no adverse impacts to O&M activities.

O&M activities and practices at Navajo Dam are not expected to deviate from those currently performed at the dam. In addition, no impacts to dam O&M personnel staffing levels are anticipated.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

Impacts under the 250/5000 Alternative would be similar to those of the No Action Alternative; however, some additional measures would need to be taken, as compared to the No Action Alternative:

- ❑ Increased monitoring by O&M staff would be carried out to monitor whether the Flow Recommendations criteria are being met and to consider the flow criteria and flow status in annual operating plan discussions. This measure is currently being implemented.
- ❑ Increased coordination would take place with O&M staff, various water users, and governmental agencies when periods of high tributary inflows occur simultaneously with high releases from the dam. This measure is currently being implemented.
- ❑ Installation of additional weather monitoring equipment may be needed to administer releases.

500/5000 Alternative

Impacts under this alternative would be similar to those under the 250/5000 Alternative.

SAFETY OF DAMS

This section addresses the potential impacts to safety of dams that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect the safety of Navajo Dam?

Overview

Scope

The scope includes Navajo Dam and downstream to the confluence of the Animas River.

Summary of Impacts

No impacts are anticipated with implementation of the No Action, 250/5000 and 500/5000 Alternatives.

Impact Indicators

Impacts could be considered adverse if predicted reservoir levels and releases exceeded the design capability of Navajo Dam.

Affected Environment

Safety of Dams O&M activities are performed under general Reclamation policies and procedures.

A 1999 Risk Analysis resulted in this facility being classified as a high hazard dam (i.e., potential loss of human life).

A major recommendation from the risk analysis was the installation of an Early Warning System at the dam. This system would notify emergency personnel of potential safety problems. Because of the warning system, the loss-of-life potential has been reduced.

Methodology

Impacts were evaluated by:

- ❑ Interviewing the reservoir superintendent, Reclamation O&M staff, and emergency, local, State, and Federal water officials.
- ❑ Examining the hydrologic modeling results for reservoir water surface elevations and releases under the alternatives considered and comparing them to historical reservoir records.

Impacts Analysis

No Action Alternative

Analysis of the hydrologic modeling results indicated that historic reservoir level fluctuations and dam releases under the No Action Alternative would be well within the designed capability of the dam. Consequently, there would be no adverse impacts to dam safety.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

Under the 250/5000 Alternative, no adverse impacts are anticipated because the dam's designed capability is not exceeded.

500/5000 Alternative

Under the 500/5000 Alternative, no adverse impacts are anticipated because the dam's designed capability is not exceeded.

HAZARDOUS MATERIALS

This section addresses the potential impacts to hazardous material sites that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect hazardous material sites?

Overview

Scope

The hazardous material sites in this analysis include oil and gas pipelines crossing the San Juan River, gas wells, sewage treatment facilities, and a Shiprock, New Mexico, radioactive material waste site adjacent to the San Juan River. The scope includes risks of flooding or other damage to sewage treatment facilities. It does not include impacts on stream water quality or associated wastewater discharge permits resulting from stream water quality standards for the San Juan River that are considered in the "Water Quality" section in this chapter.

Summary of Impacts

No impacts are projected under the No Action Alternative on pipeline crossings, gas wells, sewage treatment facilities, or radioactive waste.

Under the 250/5000 Alternative, impacts to pipeline crossings, gas wells, and sewage treatment facilities are not anticipated.

Under the 500/5000 Alternative, the impacts on pipeline crossings, gas wells, sewage treatment facilities and radioactive waste would be similar to those of the 250/5000 Alternative analysis.

Impact Indicators

Impacts were considered adverse if implementation of the No Action or action alternatives disturbed hazardous materials that would result in a health risk to the public or environment.

Affected Environment

The hazardous materials of most concern are petroleum products which are transported in pipelines under the river. Petroleum pipeline river crossings from Navajo Dam to the Hogback area upstream (east) of Shiprock are predominantly compressed natural gas (CNG) lines with a few liquified petroleum gas (LPG) lines. If pipeline exposure/ erosion occurred and the line was damaged, the CNG would be an airborne hazard, while the LPG would become a waterborne petroleum contamination hazard.

Another river crossing pipeline in the Hogback area carries crude oil from oilfields in Aneth and Bluff, Utah, and if damaged could present a serious downstream contaminant concern.

Other areas of concern include scattered gas wells in the riparian area from Navajo Dam to Shiprock and municipal sewage treatment facilities which may present a biohazard contamination to the river. In addition, there is a radioactive material waste site (Shiprock Uranium Mill Tailings Remedial Action [UMTRA] Project Site) located southeast of Shiprock on an elevated terrace about 50 feet above the San Juan River.

Methodology

Pipeline river crossing information was obtained from pipeline owners. In addition, city and county governments adjacent to the San Juan River were contacted to develop information on wastewater treatment facilities.

Information on the Shiprock radioactive material waste site was obtained from the ALP Project FSEIS (Reclamation 2000a).

Impacts Analysis

No Action Alternative

No impacts are projected under the No Action Alternative for pipeline crossings, gas wells, sewage treatment facilities, or radioactive waste because reservoir releases would be within the historic range.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

Petroleum Facilities.—Flow releases from Navajo Dam would not impact gas well sites and pipelines within and adjacent to the river's flood plain. Pipeline owners that were

contacted generally were confident that their river crossings have adequate protective depth and cover as they pass under the river and adjacent riparian areas.

Sewage Treatment Facilities.—Municipalities were contacted along the San Juan River regarding river flows' impacts to their sewage treatment facilities. The incorporated municipalities of Bloomfield, Farmington, and Shiprock noted that the integrity of their facilities has generally been unaffected by river flows since the construction of Navajo Dam, including the 5,000 cfs springtime peak releases from the dam made since 1991; therefore, implementation of the 250/5000 Alternative should have no effect.

Other unincorporated communities such as Blanco, Kirtland, Fruitland, and Waterflow, New Mexico, do not have established treatment facilities, but use individual treatment systems. No problems were noted during the Summer Low Flow Test and past springtime high flows. Hence, no adverse impacts are expected.

No sewage treatment facilities in Colorado near the San Juan River would be jeopardized. Unincorporated Utah communities such as Aneth, Montezuma Creek, Bluff, and Mexican Hat are near the San Juan River. Bluff uses individual treatment systems, and the other three communities use lagoons. The lagoon system at Montezuma Creek is located within approximately 50 yards of the San Juan River. The systems at Aneth and Mexican Hat would not be jeopardized by high river flows (San Juan County , Utah, personal communication, 1999).

Radioactive Waste.—A problem might exist at minimum flows with the contaminated groundwater in the Shiprock UMTRA Project Site area. Prolonged low flows could have the effect of concentrating, rather than diluting, contaminated groundwater interface inflows. The site, however, is downstream from the Animas River confluence in the river reach where the goal is to maintain flows above 500 cfs at all times. Thus, significant low flows would be reduced in the area compared to the No Action Alternative. Under current Department of Energy monitoring activities, any concentration changes would be identified.

500/5000 Alternative

The impacts under the 500/5000 Alternative on pipeline crossings, gas wells, sewage treatment facilities and radioactive waste are similar to those of the 250/5000 Alternative analysis.

SOILS

This section addresses the potential impacts to soils that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect soils?

Overview

Scope

This scope includes soils and erosion characteristics at Navajo Reservoir and along the San Juan River and its major tributaries below Navajo Dam.

Summary of Impacts

Under the No Action Alternative, few if any impacts would occur.

Under the 250/5000 and 500/5000 Alternatives, short-term impacts would include, but would not be limited to, bank erosion along the San Juan River, increased shoreline erosion along the reservoir edge, small landslides along the reservoir edge from saturated conditions, and increased dust concentrations in large, exposed areas around the reservoir. However, long-term impacts to river bank erosion would not be substantial due to bank stabilization.

Impact Indicators

The following impact indicators were applied because of the value of avoiding displacement or degradation of soil resources. Potential soil impacts were considered adverse if they would result in:

- ❑ Soil stability hazards
- ❑ Substantial soil losses due to wind and water erosion

Affected Environment

Soil Types

Soils in the San Juan River valley are derived from alluvial material deposited by the San Juan River and from weathering products of local geologic formations deposited in alluvial fans from side streams. Soil materials typically include sandstone, shale, siltstone, and mudstone fragments. They typically are alkaline, vary in texture from clays to sands, and are poorly stratified. Soils range from poorly to well drained and from moderately rapid to moderately slow permeability (Blanchard et al., 1993). Soils found along the river usually have a higher cobble and gravel percentage, and range from lean clay to silty gravel in composition, with the majority being silty sand. Descriptions of soils found along the San Juan River from the dam to the Hogback area are summarized in table III-23.

Banks along the San Juan River generally consist of a fine-grain soil layer overlying a gravel and cobble layer. The fine-grain soil is usually deposited as overbank deposition during floods and is classified as lean clay, silt, or silty sand. The gravel layer indicates a river channel deposit and generally consists of a silty gravel with some cobbles. Flooding can deposit a series of fine sand and gravel lenses throughout the valley bottom. Terraces developed from older river elevations can be seen along the valley and are generally composed of silty gravel with cobbles. Bedrock along the river is generally shallow (within 20 to 30 feet of the river channel bottom).

Erosion

Bank erosion commonly occurs on the outside edge of meander bends along the river, where banks are exposed to the force of the river during high flows. Banks between the meander bends are generally less steep and more vegetated. Vegetation can play a key role in preventing erosion, with dense root masses holding soil together and preventing bank erosion.

Some bank erosion occurs from Navajo Dam downstream to Blanco, New Mexico, but the river channel is generally entrenched and has dense vegetation along the bank to protect it in this reach.

A few side tributaries add fine sediment to the river during storms which cause increased bank erosion, but, in general, the river channel is in good shape. The river channel generally consists of gravel and cobbles with some fine sand.

Downstream of Blanco, New Mexico, several large tributaries add large amounts of fine sediment to the San Juan River. The largest tributary is Canyon Largo, which can add a

Table III-23.—Properties of soil map units potentially affected by project implementation[1]

Map unit Name	Slopes, depth percent/ inches	Topographic position	Surface layer texture	Subsoil textures	Permeability	Available water capacity	Runoff or erosion hazard	Main uses
Alamosa loam	0-2% 60+	Valley floors, fans, bottom lands	Clay loam	Sandy and silty clay loams	Moderately slow	High	Slow to slight	Irrigated hay, pasture, rangeland
Archuleta-Sanchez complex[2]	12-65% 10-20	Hills, ridges, mountainsides	Organic matter and loam; clay loam and stony clay loam; sandy loam	Clay loam and very stony sandy clay loam	Moderate to moderately slow	Low to very low	Rapid to moderate	Wildlife habitat, livestock grazing, woodland, homesites
Horsethief-Uinta Rock Outcrop	5-65% 50+	Cuestas, hogbacks, mountainsides	Very stony clay loam	Extremely stony clay loam	Moderate	Low-moderate	Medium to moderate	Rangeland and wildlife habitat
Big Blue clay loam	0-6% 60+	Low terraces and valley bottoms	Clay loam	Silty clay	Slow	High	Slow to slight	Irrigated pasture and rangeland
Lazear-Rock Outcrop Complex	12-65% Shallow	Edges of mesas and breaks	Very stony loam	Loam	Moderate	Very low	Medium to moderate	Rangeland and wildlife habitat
Mikim loam	3-12% 60+	Alluvial fans and foothill valleys	Loam or sandy loam	Loam	Moderate	High	Medium to high	Irrigated field crops, pasture, unirrigated crops and rangeland
Plome fine sandy loam	3-12% 60+	Mountainsides and mesas	Organic matter and fine sandy loam	Clay loam	Moderate	High	Medium to moderate	Irrigated and unirrigated crops, woodland and rangeland
Sili clay loam	3-6% 60+	Upland valley bottoms and fans	Clay loam	Clay loam	Moderately slow	High	Medium to moderate	Irrigated cultivated crops and pasture
Vosberg fine sandy loam	3-8% 60+	Swales and upland foot slopes	Fine sandy loam	Clay loam and sandy clay loam	Moderate	High	Medium to moderate	Irrigated and unirrigated crops, wildlife habitat and rangeland
Zyme clay loam	3-25% Shallow	Ridges and hills	Clay loam	Clay loam	Slow	Low	Rapid to high	Livestock grazing and wildlife habitat
Zyme Rock Outcrop Complex	12-65% Shallow	Ridges and Hills	Clay loam	Clay loam	Slow	Low	Rapid to high	Livestock grazing and wildlife habitat

[1] From soil reports and maps of San Juan and La Plata Counties prepared by the NCRS.
[2] A complex is a map unit where both soils are of roughly equal dominance.

significant amount of fine sediment into the river during thunderstorms. When fine sediment builds up in the river channel, the depth of the river decreases, causing the river to widen, which, in turn, increases bank erosion. From Canyon Largo downstream, the character of the San Juan River starts to change as it begins to meander and widen, with sand bars and islands occurring in the channel and increased erosion on the banks. The river channel becomes sandy with less gravel and cobbles exposed. Vegetation along the banks is less dense in some places, which increases the erosion potential for the area. Landowners are armoring the banks of the river with cobble riprap and other material to protect their property at higher flows. Below the confluence of the Animas River, bank erosion is less severe and the San Juan River is more stable.

Methodology

All short- or long-term, direct or indirect, or cumulative impacts were evaluated by:

- ❑ Researching the existing soil conditions from Federal and State agencies, web sites, and publications. A list of possible impacts was developed based on the information obtained from the research. The impacts included landslides, bank erosion along the San Juan River, shoreline erosion around the reservoir, and dust concentrations in exposed areas along the reservoir edge.

- ❑ Examining the hydrologic modeling results for reservoir water surface elevations and dam releases under the No Action and action alternatives and comparing them to historic reservoir water level fluctuations and releases.

- ❑ Conducting a survey by boat of most of the reservoir edge/rim. Erosion conditions, bedrock exposure, landslides, and other factors were noted. Photographs were taken for general conditions along the reservoir edge.

- ❑ Using a bank survey of the San Juan River which was conducted during the springtime peak release (5,000 cfs) in June 2001 and the low base flow release (250 cfs) during the Summer Low Flow Test in July 2001. Photographs and notes were taken of bank erosion and the general condition of the river during these times.

Impacts Analysis

Soil displacement from the operation of Navajo Reservoir under the No Action and action alternatives would occur through either water- or wind-caused erosion. Soil resources are valuable because of the variety of vegetation land uses they support; eroded soils can

subsequently lead to secondary water and/or air pollution. Large soil disturbances—landslides—can expose hazards, while bank erosion along the river can cause loss of property or water quality degradation.

No Action Alternative

Under the No Action Alternative, few, if any, soil impacts would occur. Historical operation of the reservoir has resulted in a relatively stable reservoir level with little soil erosion around the reservoir edge. Downstream releases have been controlled to the extent that bank erosion has been low, vegetation has encroached on the river, and the river has become relatively stable.

The New Mexico Environment Department in its draft 2002 Section 305 (b) report has listed the San Juan River segment from Navajo Dam to Canyon Largo as "not supported" in its designated uses due to turbidity and bottom sediments. Streambank modification or destabilization is listed as a possible cause for this, as are resource extraction, vegetation removal, grazing, petroleum activities, and agriculture. River segments from the confluence of the Animas River to Canyon Largo and from the Chaco River confluence to the Animas River confluence are listed for bottom sediments, possibly caused by streambank modification or destabilization, resource extraction, vegetation removal, grazing, petroleum, and agriculture.

In the reaches of critical habitat for endangered fish species between Farmington and Lake Powell, soil erosion from the contributing drainage area adds sediments to the San Juan River during summer and fall thunderstorms, and this sediment creates extremely turbid flow conditions and results in large amounts of sediment being deposited in the river channel. Under the No Action Alternative, peak releases from Navajo Dam may not be sufficient to scour and transport this sediment down the river, in which case sedimentation of the river bottom may continue to provide habitats that are not conducive to spawning and rearing of endangered fish.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

Under the 250/5000 Alternative, shoreline erosion around the reservoir would increase due to greater drawdowns. This alternative would cause adverse short-term impacts to river bank erosion and possible property loss downstream of Navajo Dam. During the high (5,000 cfs) flow tests in 1998 and 2000, bank erosion concerns were identified in numerous places (at least 20 sites) from the dam to Kirtland, New Mexico. Under this alternative, short-term impacts would occur from bank erosion in this stretch until the river stabilized

itself or property owners stabilized the banks using best management techniques (berms, riprap, rock vanes, vegetation, and others). Long-term impacts from bank erosion would likely not be adverse due to stabilization of the banks.

In the reaches of critical habitat for endangered fish species between Farmington and Lake Powell, soil erosion from the contributing drainage area adds sediments, as discussed above. Under the 250/5000 Alternative, peak releases from Navajo Dam are anticipated to be sufficient to scour and transport this sediment down the river, in which case sedimentation of the river bottom would not occur and habitat conditions would be conducive to spawning and rearing of endangered fish. This alternative effectively manages the tributary sediment loads into the river.

500/5000 Alternative

Bank erosion at the reservoir could be greatest under the 500/5000 Alternative due to reservoir drawdown. This alternative would cause impacts to soils similar to those of the 250/5000 Alternative.

GEOLOGY

This section addresses the potential impacts to geology that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect geology?

Overview

Scope

The scope includes the San Juan River valley, in the San Juan structural Basin, and the Colorado Plateau.

Summary of Impacts

There would be no projected impacts to geologic resources under the No Action, 250/5000, and 500/5000 Alternatives.

Impact Indicators

The following indicators were used to evaluate the potential impacts to geologic resources. An impact would be considered adverse if one of the following were to occur as a result of changes in reservoir operation:

- ❑ Reservoir-induced seismicity resulting in dangerous conditions around the reservoir or damage to facilities
- ❑ An increase in erosion and sedimentation around the perimeter of the reservoir which affected operation of the dam or caused damage to equipment
- ❑ Catastrophic landslide damage to facilities around the reservoir, or catastrophic endangerment to human life
- ❑ The potential to restrict recovery of mineral resources

Affected Environment

Navajo Dam and Reservoir are located within the San Juan structural basin, which occupies approximately 7,700 square miles in the eastern part of the Colorado Plateau of northern New Mexico and southern Colorado. Bedrock around Navajo Reservoir consists of nearly horizontal beds of sandstone, shale, and siltstone of the San Jose Formation (formerly named the Wasatch Formation), which has a maximum thickness of about 2,000 feet at the center of the Basin. The closest zone of seismicity to Navajo Dam and Reservoir is found approximately 40 to 60 miles to the east.

The San Juan River area includes the broad, terraced San Juan River valley, which is characterized by unconsolidated clay, silt, sand, and gravel, and terrace gravel and cobble deposits. The clay, silt, sand, and gravel deposits probably do not exceed 100 feet in thickness and the terrace deposits generally do not exceed 30 feet in thickness (Blanchard et al., 1993). The bedrock encountered along the river includes sedimentary strata composed of interbedded sandstone, siltstone, mudstone, and shale from varying formations (table III-24).

Methodology

- ❑ Researching the existing geologic conditions from Federal and State agencies, web sites, and publications (including landslide survey records). A list of possible impacts was developed from the information obtained. The possible impacts include landslides, shore erosion, reservoir-induced seismicity, and mineral resource recovery.

- ❑ Examining the hydrologic modeling results for reservoir water surface elevations and dam releases under each alternative and comparing them to historic reservoir water level fluctuations and releases.

- ❑ Conducting a survey by boat of most of the reservoir edge/rim. Erosion conditions, bedrock exposure, landslides, and other features, were noted. Photographs were taken for general conditions along the reservoir edge.

Table III-24.— Varying formations along the San Juan River

System	Series	Formation	Features
Tertiary	Eocene	San Jose Formation	Navajo Reservoir, San Juan River
	Paleocene	Nacimiento Formation	San Juan River, Bloomfield
Cretaceous	Upper Cretaceous	Ojo Alamo Sandstone	San Juan River
		Kirtland Formation	San Juan River, Farmington
		Lewis Shale	San Juan River
		Cliff House Sandstone	San Juan River
		Menefee Formation	San Juan River
		Picture Cliffs Sandstone	San Juan River
		Mancos Shale	San Juan River, Shiprock
Jurassic		Many different formations	San Juan River
Triassic			
Permian			
Pennsylvanian			San Juan River Lake Powell

Impacts Analysis

No Action Alternative

No impacts are projected under the No Action Alternative. Any geologic resource impacts from the operation of the reservoir would fall within historic parameters. As a result, there would be no anticipated increase in erosion, sedimentation, landslide activity or potential

restriction of mineral resource recovery. In addition, no active surface faults have been found within a relevant distance of the dam, so reservoir-induced seismicity is not expected to be a problem.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

Impacts under the 250/5000 Alternative would be similar to those under the No Action Alternative.

500/5000 Alternative

Impacts under the 500/5000 Alternative would similar to those under the No Action Alternative.

AIR QUALITY

This section addresses the potential impacts to air quality that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect air quality?

Overview

Scope

This analysis centers on air quality in the Navajo Reservoir area.

Summary of Impacts

The No Action, 250/5000, and 500/5000 Alternatives would not result in any adverse impacts, short- or long-term, to air quality.

Impact Indicators

An air quality impact would be considered adverse if one of the following were to occur as a result of changes in operation of the reservoir:

- ❑ Short- or long-term violation of any National or State ambient air quality standards
- ❑ Interference with any local air quality management planning efforts to attain and maintain air quality standards

Affected Environment

Navajo Reservoir lies within the Four Corners Interstate Air Quality Control Region with the closest ambient air monitoring sites located in Farmington, New Mexico and Ignacio, Colorado[64]. Based on data from these stations, the area north and west of Navajo Reservoir is currently designated in attainment (within acceptable limits) for all pollutant criteria. It is assumed that the Navajo Reservoir area is also in attainment for all pollutant criteria based on its being further away from industrial sites and power plants in the Four Corners area then are the monitoring sites. Most of the criteria pollutants are associated with power plants, factories, refineries, and other major sources that do not occur around Navajo Reservoir.

The major air pollutant at Navajo Reservoir is particle matter in the form of windblown fugitive (transitory) dust. Under normal conditions, blowing dust in the area depends greatly on wind speed and moisture content of the soil. Site visits indicate local dust sources are the exposed, drying lake bed at the reservoir's edge, vehicles driving on roads to oil/gas pads, recreational vehicles driving on dirt roads, and wind blowing over barren areas. Wind-blown dust can also come from far away, depending on regional weather conditions.

Some of the existing air quality impacts in the Navajo Reservoir area are from recreational ground and water vehicles, and depend on the location of recreation facilities and recreation management rather than on reservoir water level fluctuations.

Very little open area to produce fugitive dust exists around the reservoir; approximately 8 percent of the area is sandstone and shale slope, either barren or with a thin herbaceous

[64] Air emissions are regulated under the Federal Clean Air Act (CAA), enacted to protect and enhance the quality of the nation's air resources. The CAA provides National Ambient Air Quality Standards (NAAQS) and New Source Performance Standards (NSPS), a permitting process to prevent adverse deterioration of air quality, visibility limitations for national parks and wilderness areas, and limits on emissions of hazardous substances. The EPA has established NAAQS for several pollutants, including carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone(O_3), lead (Pb), and particulate matter smaller than 10 microns in diameter (PM_{10}) (Title 40, Code of Federal Regulations [CFR], Part 50).

cover, while 73 percent of the area is pinon-juniper woodland and sagebrush (Reclamation, 1999b). A large drawdown area of several thousand acres along the northern part of the reservoir has been exposed in past reservoir operations.

Methodology

Impacts were evaluated by the following measures:

- ❑ Local existing air quality material from various Federal and State agencies, web sites, and publications was examined. A list was developed from the information obtained. The impacts included fugitive dust from different sources (ground, roads, reservoir edge), vehicle or recreation exhaust and traffic patterns, and any nearby industrial sources;

- ❑ The hydrologic modeling results for reservoir water surface elevations and dam releases under each alternative were examined and compared to historic reservoir records. All model results showed the predicted reservoir water levels and dam releases were within historical range.

- ❑ The expected impacts on local and regional air quality were evaluated against Federal and local requirements for protecting public health (table III-25).

Impacts Analysis

No Action

Hydrologic analysis predicts that reservoir water surface levels would be within the range of water levels experienced historically, and dust generated by changes in the reservoir level should be within historical parameters. Oil and gas exploration is expected to continue around the reservoir, and vehicles driving to service the pads and wells will continue to cause small, localized fugitive dust. Recreational use around the reservoir will continue as is and probably increase over time, with some intermittent and periodic increases in fugitive dust associated with the construction of new recreational facilities. Overall, no adverse impact on air quality is predicted.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

Impacts on air quality under the 250/5000 Alternative would be slightly greater than under the No Action Alternative because lower average reservoir elevations would expose more soil to wind erosion.

Table III-25.—Criteria pollutants and regulatory limits

Pollutant	Period	National[1]	New Mexico[2]	Colorado[3]
PM_{10}	24-hr average	[4]150 µg/m^3	150 µg/m^3	150 µg/m^3
	annual	50 µg/m^3	60 µg/m^3	50 µg/m^3
[4]$PM_{2.5}$	24-hr average	65 µg/m^3	—	—
	annual	15 µg/m^3	—	—
Sulfur dioxide	3-hr average	0.5 ppm	—	700 µg/m^3
	24-hr average	0.14 ppm	0.10 ppm	—
	annual	0.03 ppm	0.02 ppm	—
Carbon monoxide	1-hr average	35 ppm	13.1 ppm	40 mg/m^3
	8-hr average	9 ppm	8.7 ppm	10 mg/m^3
Nitrogen dioxide	annual	0.053 ppm	0.05 ppm	100 µg/m^3
Ozone	1-hr average	0.12 ppm	—	235 µg/m^3
	8-hr average	0.08 ppm	—	—
Lead	annual	1.5 µg/m^3	—	—

[1] Source: 40 CFR sections 50.4 through 50.12 (1999).
[2] Source: New Mexico Ambient Air Quality Standards 20 NMAC 2.03 (1996).
[3] Source: Colorado Ambient Air Quality Standards, Colorado Air Quality Control Commission (2000)
[4] The new $PM_{2.5}$ (particulate matter) standards have not been implemented.

500/5000 Alternative

Impacts on air quality under the 500/5000 Alternative would be greater than those under the No Action and 250/5000 Alternatives since reservoir elevations are lowest under this alternative.

NOISE

This section addresses the potential impacts to noise levels that could result from actions associated with the modified operations of Navajo Dam and Reservoir under the alternatives considered.

Issue: How would the No Action and action alternatives affect noise levels?

Overview

Scope

The analysis of noise encompasses Navajo Reservoir and the San Juan River and related formal and informal recreation sites.

Summary of Impacts

There are no noise level impacts projected under implementation of the No Action, 250/5000, and 500/5000 Alternatives from recreational use of the reservoir and from releases to meet Flow Recommendations criteria.

Impact Indicators

The indicators used to determine noise impacts centered on whether the following effects would be caused by changes in dam releases as a result of the alternatives:

- ❑ Noise generated that exceeded established ordinances or criteria
- ❑ Substantial increases in noise levels over existing noise levels in noise-sensitive areas
- ❑ Noise that would be disturbing or injurious to wildlife

Affected Environment

In general, the dominant sounds in the project area originate from natural sources— water, wind, and wildlife. Except for developed recreation areas at Arboles, Pine River, and Sims Mesa, the lands adjacent to the reservoir are relatively undeveloped and somewhat remote. Noise levels and patterns at the developed recreation areas and some of the more frequently used informal use areas (such as Colorado Cove, Frances Cove, Arboles Point, Miller Mesa, and Sambrito) are localized and typical of campground/day use recreation areas. The Navajo Reservoir Draft Resource Management Plan (RMP) (Reclamation, 1999b) identified several noise sensitive areas: Pine River and Sims Mesa Recreation Emphasis Areas, San Juan River downstream of the dam, Simon Canyon Recreation Area, Carracas Mesa and Negro Canyon Special Management Areas, and the Reese Canyon Research Natural Area. Beyond these formal and informal recreation areas, the most conspicuous noise producers are power boats and jet skis on the reservoir.

Localized traffic noise is generated from Colorado Highway 151 from Arboles to the upper Piedra Arm. State Highway 511 in New Mexico also generates localized vehicle noise as it enters Reclamation lands northwest of the Pine River Recreation Area and continues south across the dam to parallel the San Juan River. State Highway 511 in New Mexico generates localized vehicle noise along the entire stretch of the San Juan River. While often present, highway noise is obscured by topography and the sound of the river in many locations.

In addition, each day use area along the river has a dirt access road. Noise levels from these roads are localized and generally inconsequential. Traffic on the dirt roads within and near Reclamation lands is typically much lower in volume, lower in speed, and less continuous than traffic on major roadways.

Nonrecreation-related noise sources include the operation of various gas wells. Depending upon their distance from recreation sites, this machinery produces a noticeable background hum. Numerous gas and oil wells surround the reservoir; the noise produced by these wells can be loud and is generally localized, coming principally from generators. Where one or more large compressors are located at a site, the noise generated can be significant and best management plans are used to lower the noise levels. Noise from the wells is regulated by applicable noise specifications from the Federal Energy Regulatory Commission (FERC) and in Colorado by the State Noise Law and La Plata County Land Use Regulations.

Methodology

The applicable noise specifications are set by FERC[65]. Since the noise level at oil and gas sites is expected to fluctuate up and down over a 24-hour period, the design criterion is for a maximum A-weighted noise level from the compressor at the nearest receiver of 48.5 dB(A).

The State of Colorado and La Plata County have laws and regulations that protect the public from noise becoming a public nuisance by limiting the amount of noise during the daytime and nighttime. These values range from 55dB(A) for residential areas during the daytime to 45 dB(A) during the nighttime. Commercial, light industrial, and industrial areas have higher values.

[65] Noise levels are measured in decibels (dB), but to account for greater human sensitivity to sound in the midrange, a weighted "A" scale (dB[A]) has been derived. The daytime range is generally from 30 dB(A) to 90 dB(A), with the upper value represented by heavy truck traffic at a distance of 50 feet. In addition, the Federal Highway Administration Noise Abatement Criteria provide an L_{dn} value for outdoor noise, which is the level exceeded only 10 percent of the time in the noisiest hour of the day; 60 dB(A) values are for areas mandated for serenity and quiet and 70 dB(A) in active public use areas. The applicable FERC specification: 7C Filing requirements of an L_{dn}=55 dB(A) at the nearest receiver.

For evaluation of effects, a list of existing noise impacts was developed from a literature and web search and is provided in the "Affected Environment" section (above). The hydrologic modeling results for each alternative were compared to historical reservoir records. All model results showed the predicted reservoir levels were within the historical fluctuations. The existing noise impacts were compared to expected impacts and conclusions were drawn about significance.

Impacts Analysis

No Action Alternative

No adverse impacts are projected under the No Action Alternative because noise impacts in the reservoir area would depend more on management of the reservoir recreation facilities and the growth of oil and gas exploration than on dam operations. Recreational use is projected to increase, and noise from more visitors, recreational water vehicles, and traffic can be expected. Additional noise will occur from increasing oil and gas exploration wells and compressors. Long-term impacts to noise-sensitive areas have the potential to increase.

250/5000 Alternative (Preferred Alternative) (Flow Recommendations)

Impacts under the 250/5000 Alternative would be similar to those under the No Action Alternative.

500/5000 Alternative

Impacts under the 500/5000 Alternative would be similar to those under the No Action Alternative.

IV. Summary

Other Impact Considerations

The Council on Environmental Quality regulations for implementing NEPA require the determination of short and long-term impacts, direct and indirect impacts, irreversible and

irretrievable commitments of resources, and unavoidable adverse impacts. The regulations also call for the consideration of the relationship of the proposed action and its impacts to other projects and activities in the area. The relationship can be direct, indirect, or cumulative in nature. Connected actions are those actions which are interrelated with the proposed action; cumulative actions are those actions, which, when viewed with other proposed actions, have cumulatively significant impacts; and related actions are those actions which, when viewed with other proposed actions, have similarities to the proposed action that provide a basis for evaluation together, such as common timing or geography.

Short-term impacts of the proposed action would not be considered adverse; there is no construction associated with the project and short-term impacts are most often related to construction activities. However, the action alternatives would result in major long-term changes in release patterns from Navajo Reservoir and associated impacts would be long-term. Thus, changes to resources such as the trout fishery, hydropower, and recreation, discussed previously in this chapter, are considered long-term impacts. These changes are not necessarily irreversible or irretrievable and future adaptive management efforts or changes in the status of the endangered fish may refine them. Physical or economical constraints, which might occur with a major construction project and that reduce the practicability of reversing a decision or proposed action, are not present on this project. Potential long-term adverse impacts to American Indian water rights as a result of the way Navajo Dam and Reservoir are operated may be avoided or lessened as a result of future adaptive management activities or changes in the status of endangered fish. It is also possible that administrative, legislative or judicial interventions may be required to fully address the cumulative impacts to Tribal water rights, not just from the more immediate action of re-operating Navajo Dam and Reservoir, but from a variety of activities that have occurred in the Basin over the past 150 years.

Connected closely to new operations of Navajo Dam are water developments on the San Juan River or its tributaries. The ALP Project is an example; the initial catalyst for considering a change in operation of Navajo Dam was the ESA consultation for the ALP Project. As a conservation measure under the ALP Project as now planned, Reclamation has committed to operate Navajo Dam to mimic the natural hydrograph of the San Juan River to benefit endangered fish and their habitat by following the Flow Recommendations (Holden, 1999). In addition, the completion of NIIP is closely connected with reoperation of Navajo Dam. The reoperation of Navajo Dam provides the basis for ESA compliance and NIIP's completion.

The operation of Navajo Dam and Reservoir to mimic the natural hydrograph on the San Juan River is a key element in the strategy to facilitate recovery of endangered fish species while providing the primary mechanism that allows ESA compliance for continued water development. Other elements of the SJRBRIP, such as providing fish passage and endangered fish stocking, are related to the reoperation of Navajo Dam and together are designed to assist in the recovery of the endangered fish.

The cumulative effects of projects such as the ALP Project, completion of NIIP, and other new or existing water uses, such as the Florida, Mancos, and Dolores Projects, have been built into the analysis of impacts in the DEIS. Hydrologic analysis for this DEIS has taken into account diversions and depletions from these projects, and streamflow and reservoir content changes with reoperation of Navajo reflect these diversions and depletions. Thus, impacts to the trout fishery, irrigation diversions, recreation, hydropower, Indian trust assets, and other resources are based on foreseeable cumulative impacts. Table II-1 shows existing and future depletions that have been included in the hydrology analysis.

In addition, the DEIS recognizes that additional depletions may occur in the future beyond those shown in table II-1. The proposed plan does not preclude future development of water, including possible future uses of Indian trust water, not listed in the table. The proposed plan is viewed as a key element in recovering endangered fish, which, in turn, can support future water development. Chapter II includes a section that discusses how these projects would be reviewed in terms of compliance with the ESA.

Environmental Resources Summary

Short-term impacts would not be considered adverse under the No Action, 250/5000, and 500/5000 Alternatives described in this DEIS. The two action alternatives would result in major long-term changes in release patterns from Navajo Dam. These changes are not irreversible or irretrievable and future adaptive management efforts may refine them.

The action alternatives, particularly the 250/5000 Alternative, would improve habitat conditions to help conserve endangered fish in the San Juan River in conjunction with other activities: fish passageways, nonnative fish control, and fish stocking. The 250/5000 Alternative and other SJRBRIP activities would provide ESA clearance to complete water developments for the ALP Project, the NIIP (Blocks 9-11), and other water uses. This, in turn, would help meet Federal trust responsibilities to protect, maintain, and develop water uses under water rights reserved by or granted to American Indian Tribes or Tribal Nations.

Operational changes under the 250/5000 Alternative would have adverse impacts on a regionally important trout fishery and associated recreation uses and economic benefits. Other negative impacts would occur to water diversions, water quality, and hydropower production. More natural river flows under the action alternatives would benefit important riparian areas along the San Juan River.

Biodiversity

Biological diversity, or biodiversity, is a general term applied to the fundamental ecological concept that all living things are connected in some way. The general premise of life on

earth is that species of fish, wildlife, and plants have adjusted to the environmental conditions particular to the areas of the planet where they exist. Changes to those conditions, either natural or man-caused, often result in a decline in the numbers and variety of species and a disruption of the established interactions among remaining species. It is generally accepted that the more natural an environment remains, the healthier, or better able, it is to withstand all but major catastrophic events.

Figure III-20.—Wildlife nesting areas on the San Juan River.

A change in biodiversity associated with the historical San Juan River occurred when Navajo Dam was constructed and placed into operation. The dam and reservoir physically altered the river and the surrounding terrain and modified the pattern of flows downstream. As is typical with dams constructed in the southwest United States, the San Juan River downstream of the dam became clearer due to sediment retained in the reservoir, and the water became colder, because it is released from a deep pool of water. Species of fish and other aquatic organisms, and those forms of life that existed along the river channel, were all affected to varying degrees. The conditions of the river immediately downstream of the dam became less favorable to the native fish species that live in warmer and turbid waters. The disruption of natural patterns of flow caused changes to the vegetation along the river banks by altering the previously established conditions under which the plants reproduced and were sustained.

In addition to the changes caused to the river by the dam, there were changes to how the lands in the area were used. Irrigation water provided by Navajo Dam enabled agriculture to be practiced on a large scale. That further affected the river and the native species dependent on the river both directly, through flow diversions, and indirectly, through changes in water quality, as a result of the water acquiring salts, pesticides, and fertilizers

from the irrigated lands' return flows to the river. Also, over the last century, the river has experienced diversions for human consumption and use at towns and cities, resulting in a variety of return flows to the river, including industrial waste, stormwater runoff, and discharges from sewage treatment plants. Compounding these changes has been the appearance of non-native species of fish and plants, creating competition with native species.

The 250/5000 Alternative (Preferred Alternative) is expected to contribute to stabilizing native biodiversity in the San Juan River downstream of the dam. The Flow Recommendations criteria are intended to provide for restoration of more natural, pre-dam hydrologic and hydraulic conditions in the river downstream from Farmington and by so doing, to conserve the native razorback sucker and Colorado pikeminnow populations. It is expected that other species that are part of native biodiversity would also benefit.